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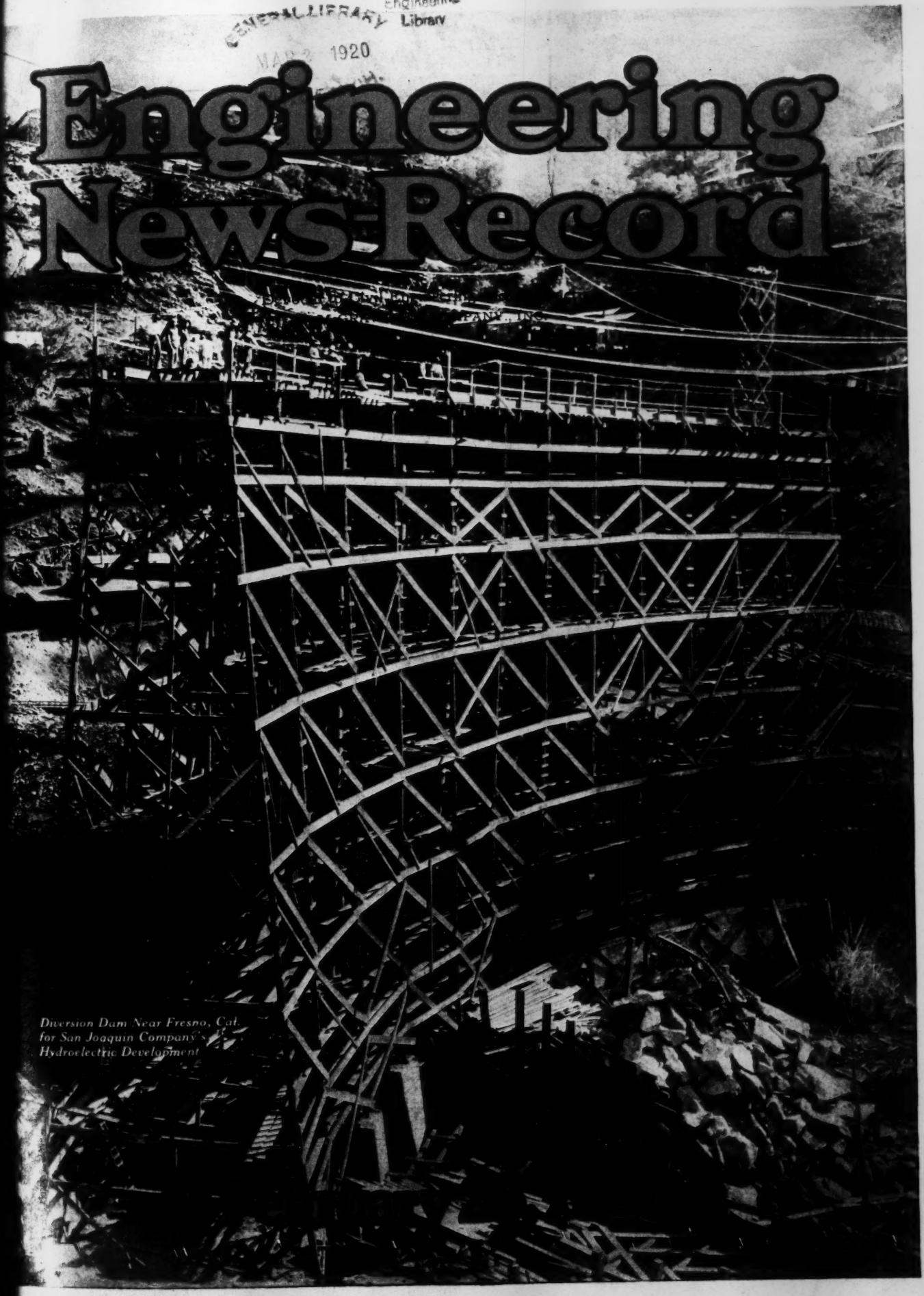

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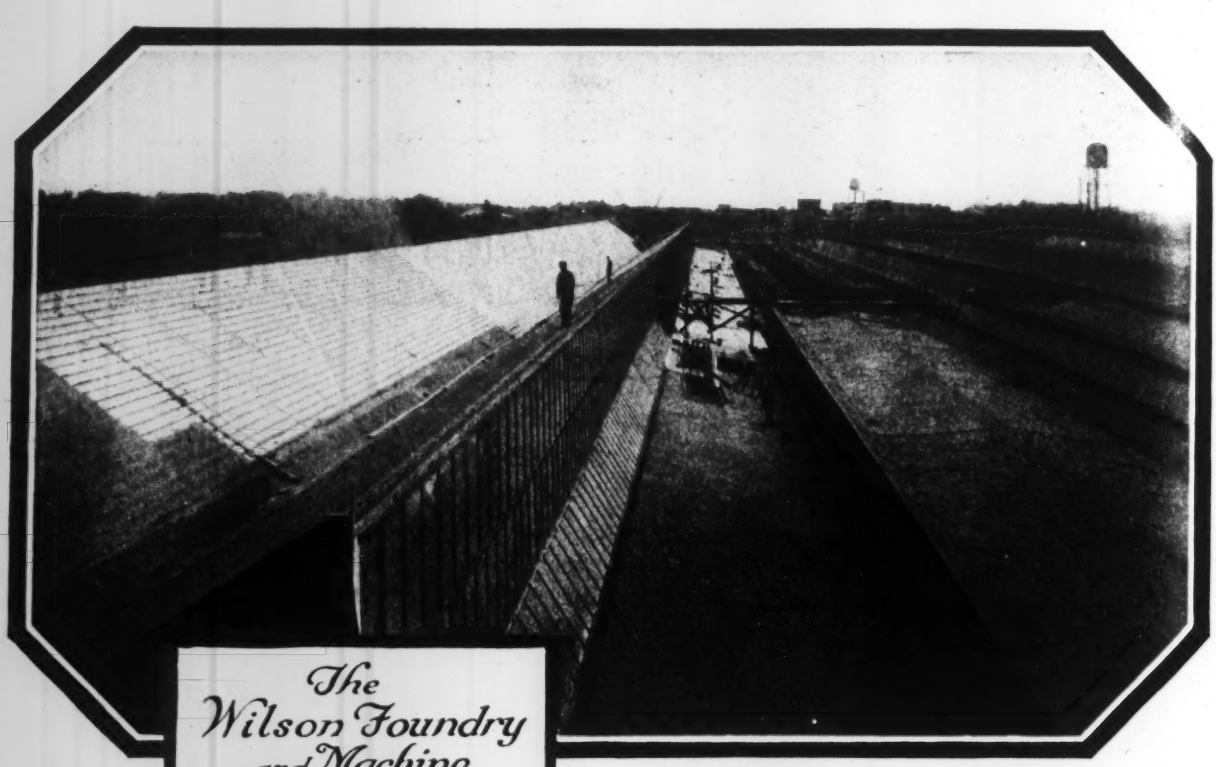

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

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Hoover, President of Miners

THE profession is honored in having its leading citizen accept the presidency of one of its leading societies. Herbert Hoover last week became president of the American Institute of Mining and Metallurgical Engineers. If he puts into it but a small part of his strenuous energy and of his great vision the year should be a notable one in engineering annals.

We Talked, Canada Acted

FOR nearly ten years we have been talking about water-power legislation, legislation that would protect the public, but also encourage the development of powers running to waste. Only now have we progressed to the point of advancing a bill to Congressional conference. While we talked, Canada acted. In Ontario development proceeded apace. We may not approve the method—government ownership—but wasted waters were conserved. In Quebec, not only was development encouraged, but the Province went down into its own treasury and built headwater works to conserve the floods against the low-flow season. Mr. Lefebvre, on page 423, tells the whole story. The investment made by the Province is being amortized at a rapid rate. Before long there will be a cash surplus for the Province, in addition to the inevitable returns to government from stimulated industry. And—let's write it large so that all may read—while the government has made a wise investment the power producers are happy, and are extending their work. On this side of the international boundary we need less talk and more action.

A Neglected Feature

UNDOUBTEDLY the concrete housing conference at Chicago last week did a great deal of good. It brought together on the one hand a number of men who know how to build concrete houses of one type or another and to confer with them men who are acquainted with the necessities and difficulties of home financing. Each group can learn much that is needed from the other. There was left unsolved, however, the most critical element in the whole situation, that is, how to get the labor and material to carry out the building that is necessary. Admittedly the country is in crying need of houses. They are not being built, because, first, each one costs so much and, second, because there are difficulties in financing the small home owner. But even assuming that the deliberations of last week's conference solved these two difficulties, houses could not be built in sufficient number literally because there is not available in this country sufficient material. Cement mills will not be able to meet the demands for roads; there is no choice in sizes or quality of lumber; bricks, structural steel, everything that goes into a building, is slow or absent in delivery. Here is the real problem: How to speed up production. There may be solutions of it, but they are not found in any campaign to increase consumption.

Engineering Affiliation at Spokane

ON ANOTHER page J. C. Ralston tells about the workings of the five-year-old affiliation, known as the Associated Engineers of Spokane. This organization, contrary to the practice in most of the affiliations now in existence, is composed exclusively of sections of the national engineering societies. The sections themselves take care of their technical functions and the affiliation deals only with the broader interests. Through this plan young men who desire to be affiliated with the leading engineering organization of the city are encouraged to go into the nationals; in fact, they cannot have part with the federation unless they do. Mindful, however, that there will always be desirable men who cannot become members of the nationals, a plan is under contemplation to create a new class of member, to be called "Staff Member." We suggest the consideration of this plan to those local sections which desire to affiliate and restrict their voting membership to members of the nationals. Some provision must in such cases be made for the unattached member, and the Spokane plan commends itself as an effective method of accomplishing the result.

Withdraw From Employers' Alliance

IN OUR issue of Oct. 23 we commended the action of Morris L. Cooke in calling attention to the unfortunate action of the American Society of Mechanical Engineers in taking membership in the National Industrial Conference Board, an employers' organization which sponsored the employers' side in the first National Industrial Conference. The society, which obviously should be impartial, adhered to a partisan interest. We are glad to learn that it has now withdrawn its membership, following the report of a special committee appointed to look into the matter. The committee, however, did not discuss the stultifying nature of the alliance. Its conclusion was based on the inadvisability of diverting the society's funds to non-society purposes. It is unfortunate that the broader principle was not taken up squarely, for a fundamental statement would have been a guide for the future.

Water Conservation in California

URGENT need for immediate steps to conserve water for irrigation, city supply and hydro-electric power in California is indicated by the official announcement of low snowfall in the high Sierras, reported on p. 429 of this issue. Short as the time may be, efforts should be made to extend the use of meters on water supplies for irrigation as well as city use. Temporary

works for storage and the addition of flashboards and the utilization of all other feasible means of raising the water level in existing storage reservoirs should be given consideration as possible means of relief. Inspection and educational campaigns against water waste would be of help in many cases. The general subject should not be dismissed without referring to the value of snow surveys to gain the earliest possible knowledge of summer water conditions in the far West. Such surveys have been carried on to some extent for years past, but it seems certain that their number and intensity should be increased. An article dea'ing with methods and results of these snow surveys appeared in *Engineering News-Record* of Oct. 19, 1919, p. 1110. It will bear close study at this time by all who are concerned with summer streamflow depending upon snowfall.

New York's Traffic Experiment

IN AN effort to relieve the rush-hour traffic congestion which has made Fifth Ave., New York, almost impassable for motor vehicles, a one-way traffic scheme is to be tried. Between 34th and 57th Sts. from 10 a.m. until 5 p.m., as explained in further detail in the article on p. 434, all traffic—six lines of vehicles—will proceed only in a southerly direction and will be controlled by a system of signal towers and lights. The experiment will be watched with much interest, for any improvement on present methods of handling traffic on congested streets will prove a great boon to both users of vehicles and pedestrians. The plan is to have the Fifth Ave. traffic move south for 1½-min. intervals, separated by 1-min. periods of rest, in order to allow east-and-west traffic to cross the avenue. The seriousness of the present situation is indicated by the fact that by actual test it has taken a vehicle as much as 40 min. to proceed from 57th to 34th Street, a distance of slightly more than one mile. Any scheme of traffic control which can reduce such intolerable delays will be welcomed and will find application in other congested portions of New York and in other large cities.

Concrete a Changing Science

ENGINEERS who think that concrete design is a finished book or that concrete practice is an established system would do well to consider the proceedings of last week's convention of the American Concrete Institute. At least five times at that meeting there came to the fore issues or actions which indicate the insufficiency of our knowledge or the changing standards of our practice; in fact, dissatisfaction with the narrow limits of what we know about concrete stands out as the feature of the convention. First, there was the initial announcement of the organization of the Joint Committee, starting once again to define and specify what its predecessor finally settled only three years ago. Then there was the elaborate, and somewhat radical, report on shear with its promise of still greater increases in the safe limits of that hitherto restricted stress value. Along the same path was the Slater and Zipprodt recommendation for a different compression unit measure which would utilize actual test strengths. In construction fields, the discussion on floor finish was informing, not that it helped much in telling how to get a good floor surface, but because it made quite clear that here is a feature of concrete construction where the experts confess, if not failure, at least ignorance of how to avoid failure. Finally there was the good start toward the hitherto non-existent standardization of structural shapes and sizes. All engineering science must of course move forward, but that particular branch relating to concrete seems just now to have an extraordinary acceleration.

Louisville Highway Convention

WEEK before last the American Road Builders' Association held its annual convention in Louisville. The meeting was a failure. The attendance was woefully small; the program was marred by the absence of a number of important speakers. The exhibit was excellent—but barren of visitors. Among the manufacturers there is more acrimonious criticism of the failure than among the engineers. The debacle is all the worse because the association is the only national technical organization in the highway field. Yet, should we call it *national?* For years it has been governed by a handful of eastern men who have never succeeded in bringing into active membership the live highway engineers and contractors of the great Middle West. As long as they remain in control, the organization will not prove equal to its opportunity. It will remain chiefly an eastern association. Reorganization must come this year or active spirits will demand and build a new organization—and one that will be truly national. In the most active field of engineering there should be a competent organization.

Adrift From Its Traditions?

THERE is being sent to the membership of the American Society of Civil Engineers a circular signed by 106 members of the society, entitled "A Word of Caution." The circular advises that there be a negative vote on question 3 of the questionnaire ballot now going to the membership. Question 3 asks whether the society shall join in the creation of a comprehensive organization as outlined in the Joint Conference Committee's report. As indicated in the reprint of the circular found elsewhere in this issue, the purport of the argument is that the new movement will cut the Society "entirely adrift from its traditions." We feel that the fears of the signers of the circular are unfounded. The society is to be left unmolested in its technical field. It will still be free to take what action it desires on civic and welfare matters that are of interest only to civil engineers. On questions, however, which are of interest to all engineers it would co-operate with societies throughout the country. This is certainly not cutting the society adrift from its traditions. Its traditions are left undisturbed. It does place the society in a new work, that of participating in active efforts to improve the status of the engineer and to discharge his civic responsibility—a new work that, we believe, is favored by the majority of members of the society. The circular does not go to the essential point of discussing whether or not this broadened work is necessary. Until its signers face that issue squarely and present an adequate plan for doing that work, if needed, their word of caution should go no further than to get each member of the society to weigh for himself carefully the need and method for joint activities of engineers before casting his vote. Words of caution are always wise and advisable but the "Word of Caution" in this case fails to meet the issue squarely.

Track and Locomotive

IT WILL be sincerely gratifying to every reader who has concern in the scientific development of engineering work to observe that the second report of the Track Stress Committee fully bears out the high promise of the first report, made two years ago. At that time it was recognized that the committee's monumental investigation surpassed all prior engineering researches, certainly those in the field of civil engineering, in respect to its magnitude, the difficulty and importance of the problem dealt with, the brilliancy of methods applied to its solution, and the success achieved. It seemed unlikely that the continuation of the work would maintain the same high level. But the second report merits appreciation fully equal to that due the earlier report. It definitely places civil engineering research on a new and higher plane, and will long be a fruitful inspiration to the study of other difficult problems presented by civil engineering works.

But it is necessary to turn away almost at once from thought on the excellence of the committee's work, to consider a matter of gravest import contained in the results made known by the present report. Briefly, the new measurements of rail stresses effectively destroy the assurances of security and of a satisfactory status of the railway-track subject which appeared to be given by the first report.

Two years ago it was shown that traffic loads, even the very great loads of modern locomotives, do not menace the integrity of track. This was decidedly welcome news, for engineers had long been engaged in dispute about whether rail stresses were conservative or excessive, and whether failures and wrecks were chargeable to overloading the rail. Now, however, it develops that the load stresses are only a small part of the matter. Imperfect balancing on the one hand, and a somewhat mysterious but very definitely measurable nonperiodic effect of speed, combine to multiply the static load stresses by two, three or even four. At once we are carried out of the region of safety into one of serious uncertainty, not to say danger. When we are told of rail stresses reaching 45,000 and 55,000 lb. per square inch, further increased by lateral effects and the like, the case begins to grow seriously uncomfortable.

Hitherto, track troubles have always been charged to railway construction and maintenance engineers; but at the present moment the situation is changed, and the indictment clearly lies against their colleagues of the motive-power department. Bad locomotive action is at fault, not inadequate track quality. And this bad action is not due to a single cause; imperfect balancing is the most important, but many other features of locomotive construction and maintenance are involved. On the facts presented it must be said that further progress in railway safety and economy depends on what the motive-power men will do to improve the action of their machinery.

Primarily, counterbalancing of locomotives is lamentably imperfect. Great pulsating forces are set up, which tend to pound the track to pieces. Even in normal, "well" balanced locomotives the moving parts, which of course are a very small part of the whole machine, act on the track as though they were a load equal to half the entire locomotive. But it seems to be little more than luck that the action is not much more severe. Locomotive builders, men with years of accumulated experience and presumably able to build well, occasionally turn out "badly balanced" machines, apparently without being aware of the fact; and in such machines the load effect of the small moving parts is sometimes over twice as great as the weight of the whole engine.

In the tests it was found possible to improve the balance by lightening some of the moving parts, which were needlessly clumsy and heavy. But it has been known for many decades that the whole engine-balancing problem depends on first making the reciprocating masses as light and efficient as possible. Locomotive builders heretofore appear to have found it simpler to ignore this fact—a matter that seems to be more or less one of neglect. Further, it develops that ordinary care in computing and placing weights is not always used, so that the division of load between the several drivers is often quite different from what it is believed to be. Worse yet, one side of a locomotive may be so different from the other (probably heavier) that it produces one-fifth greater stress in the rail.

That even the best balancing is imperfect arises simply from the fact that old-time engine practice has survived in locomotive building, namely, the practice of making the counterweight do duty for both rotating and reciprocating balance. It is not possible to accomplish this result, and the compromise leads to unbalance both vertically and horizontally. But even beyond this, the dictates of convenience are made superior to those of balance, and when one driver becomes too crowded with mechanism to accommodate enough counterweight conveniently the deficiency is put on an adjacent driver. Locomotive builders may learn, to their benefit, from the track-stress measurements, that this makes their engines actually worse than if no attempt at all were made to supply the deficiency.

One very good excuse for the locomotive situation exists in the fact that no criterion of satisfactory locomotive action has been available. Almost the only guide was frequency of derangement or high repair charges of the machine; and this of course would tend to bring about the construction of robust track-destroyers, engines that would not suffer injury themselves no matter how severe they were on the track. There is now made available, in the track stress committee's reports, so much information on track and locomotive relations that it may be described, perhaps a little optimistically, as opening the way for a radically new era in the locomotive field. One thing is certain in any event: the track-stress measurements constitute an irresistible demand for a changed attitude in motive-power matters. Heretofore locomotives have been built without regard to track. In future their builders must give first thought to track.

Safety is one reason. Economy is another. If certain traffic economies are secured by using engines that destroy more track value than their extra earnings can pay for, they are bad engines. Just at present the efficiency of our expensive track structures is cut in half by locomotive imperfection—and this is a very serious loss.

Many resources and possibilities are available in the field of locomotive construction, and it is now clear that they have not been drawn upon. There is plenty of room for improvement in detail, or else the lightening of reciprocating parts by which track stresses were

reduced, in the committee's experiments, would not have been possible. But there are even wider opportunities for radical changes. The treatment of the trailer axles, as to position and load; the distribution of load over the wheelbase; the balancing of reciprocating parts separate from the rotating weights; these are among the more obvious ones—together, perhaps, with increased care of detail design and precision of construction. All possibilities need most careful restudy, under the spur of necessity made sensible by the track-stress studies. Indeed it may be said broadly that railway engineering has today no greater or more pressing problem than that of locomotive improvement.

Engineers for Snow Removal

BELATED recognition of the need for engineering advice on the problem of removing snow from the streets of New York City is indicated by the announcement made late last week that Mayor Hylan had appointed a committee of eleven representatives of city departments and bureaus to constitute a board on snow removal. Of this number six are engineers, including representatives of the Board of Estimate and Apportionment, the Department of Water Supply, the Department of Plant and Structures, and the consulting engineers to the presidents of the Boroughs of Manhattan, the Bronx and Brooklyn. In addition, there are members from the Fire Department, Police Department. Street Cleaning Department, Board of Standards and Appeals, and the Health Department.

Following the storm which so completely paralyzed traffic in the city for more than two weeks, the naming of this board is in the nature of locking the stable doors after the horse has been stolen. Nevertheless, the fact that engineering advice on this most critical question is being sought is encouraging and is in line with the plea made in our editorial last week. There the point was made—and should be re-emphasized—that snow removal is an engineering problem and one that must be provided for by careful advance planning. New York was treated to the spectacle of watching its Mayor endeavor to open up the stormbound streets by official proclamation. The job cannot possibly be handled by waiting until the streets have become impassable and then casting about for ways and means of clearing them. The utterly inefficient way in which the one steam shovel was utilized is an illuminating example of the lack of forethought on the part of those responsible for the work. The trouble was not with the machine itself, but with the lack of system which allowed it to wait often for more than a half an hour for empty trucks.

In addition to formulating plans to meet the administrative and organization questions which will arise with each big storm, the newly created board should study the possibilities for snow removal work of ordinary contractors' plant, which, in emergencies, might be quickly mobilized and operated on a rental basis. The street cleaning commissioner is directly charged with responsibility for snow removal, and yet the chief of the Fire Department has been selected as head of the snow-removal board. The failure of Mayor Hylan to name the commissioner of street cleaning as the chairman of the new body is a convincing acknowledgment of the incapacity exhibited in attempting to handle the recent storm.

With engineers mapping out a plan of attack for future storms and making provision well in advance for all contingencies, a repetition of the traffic conditions which have been a disgrace to the city should be avoided.

The Railroad Bill

WHEN the legislation covering the future status of the railroads was approached half a year ago, it was patent that three essential conditions had to be fulfilled: it had to be fair to the public, fair to the owners, fair to the employees. In addition, the new arrangement had to be such, if private ownership were to continue, that private capital would be attracted to the properties, that there be provision against loss during the transition period, and that there be Government loans until the new rates could again stimulate investment.

Now that the conferees have reported the bill and it has been passed by both the House and the Senate, it is gratifying to note that the essentials have been cared for.

The public is protected by retaining Government supervision and control of security issues, of consolidations, of the joint use of terminals and facilities, of the building of new lines and the abandonment of old, and, of course, of service and rates.

The owners are treated fairly in that there is set a definite rate of return, while efficiency is encouraged by allowing the carriers to share equally with the Government in the profits above the definite return. There is no guarantee by the Government, but it is ordered that the rates be fixed so as to produce, for the first year and a half at least, a 5½ per cent return.

Fairness to the employees it is hoped to secure by a standing board of arbitration, on which the employees, the carriers and the public will have representation. The creation of a standing board is a desirable departure, for there will be the inevitable result of building up a body of decisions having a logical relation to each other, with the result that the labor conditions on the railroads will tend to be stabilized. Strikes without fair notice will be probably avoided by the machinery proposed.

Finally, the guaranteed return of the war period is continued for six months, and a fund, inadequate it is true, is provided by the Government from which the railroads may borrow during the time when the new rate-structure is being fixed.

Considering the complexity of the problem and the pressure from diverse and conflicting interests put upon Congress, the bill is better than was to be expected. It meets the essential conditions and is better than either of the measures from which it was evolved.

Such commendation does not imply that the bill could not be improved in some particulars.

The greatest shortcoming, it is our belief, is in the failure to create a transportation board to have jurisdiction in operating and administrative matters, as distinct from the judicial province covered originally by the Interstate Commerce Commission. Despite the increase of membership of the commission from nine to eleven and the increase of its staff, it will be a body even more overburdened in the future than it has been in the past.

The commission must determine the rate of return

after March 1, 1922, and the basis of "value" both now and after that date. Congress, therefore, has placed the entire future of the lines, except as checked by the courts and modified by future legislation, in the hands of the commission. In doing so, it has, fortunately, set a good precedent in fixing a definite rate of return and allowing the carriers to share in the profits created by their efficiency. Of course, controversy is to be expected over what constitutes "value" for rate-making, but the commission again has had a good example in the obvious desire of Congress to be fair.

The conference bill takes a flat half of "excess" earnings above 6 per cent from the carrier to be applied by the commission to the general transportation contingency fund, allowing the carrier to retain the remainder. The flat "take-off" of one-half, above 6 per cent; will probably not discourage efficient management.

Everything considered, we have reason for satisfaction at the outcome of this long-drawn-out controversy. If the President approves the bill, and the Interstate Commerce Commission carries out its obvious intent, the railroads can get down to hard work with the justified hope that their efficiency will be rewarded.

Coming Battle Over St. Lawrence Route to the Sea

THE first guns in what promises to be a long-drawn battle will be fired on March 1, when the International Joint Commission opens its hearings on the proposed development of the St. Lawrence River. The discussions will be acrimonious, and sectional animosities will run high. For some years we may expect arguments of the kind that preceded the beginning of the New York State Barge Canal and which seem to be inseparable from any proposed waterway project. It behooves engineers, therefore, who are, after all, the experts who should influence public opinion in matters of this sort, to approach this great public question with a clear idea of what it means.

The St. Lawrence River, from the foot of Lake Ontario to the head of ocean navigation at Montreal, drops 222 ft. in 183 miles, the upper 113 miles of which forms the international boundary. Through this valley, with its falls concentrated in comparatively short stretches, there is a mean flow of 241,000 sec.-ft. of water, with a variation from the mean of only 25 per cent. Around the falls and rapids there exists a shallow canal with short locks and one large power canal which diverts and develops about 95,000 hp., but the waterways are entirely inadequate for full-size lake or ocean shipping, and the power developed is only a fraction of that possible by the full use of head and flow. What is now before the International Joint Commission is the possibility of the international development of the river so that ships can be brought from the Great Lakes, for the present via the enlarged Welland Canal around Niagara, and so that the two riparian nations can jointly participate in the magnificent power the river permits.

On this side of the border, advocates of the scheme come from the great Northwest, which sees a cheap outlet to the sea in bottoms which can go from Montreal right to the lake cities; the opponents are those New Yorkers who fear for the prestige of the country's premier port and foresee the abandonment of the costly Barge Canal. Minor opposition may be expected from the coal interests who now sell northern New York and Canada and the trunk-line railways which tie the Atlantic seaboard to the Northwest. Finally, there will doubtless be those who would step warily in any international development which involves commerce and large expenditures of funds.

The arguments on both sides are too voluminous to record here, but certain fundamentals can be set down. Sooner or later the immense power of the St. Lawrence must be developed. So great a natural resource cannot much longer be neglected, because it happens to lie on an international boundary. If there are complications, diplomacy must overcome them. If there are prospective preponderances of benefits, engineering agreement must adjust them. Coal is getting every year more costly to bring to the districts removed from the mines. Hydro-electric power is every year becoming more an economic necessity. The people of the United States and Canada cannot afford not to use the St. Lawrence power.

The power necessities seem to us to be predominant, but navigation must be studied, too, because when power is being developed it is simpler to provide for navigation necessities than were they considered alone. This phase of the question must be studied nationally and not locally. The time has passed when one section of the United States can dictate national policy. There must be balanced, on one hand, the countrywide benefits which will unquestionably accrue from a cheap through transportation from the Great Lakes to the sea, and, on the other, the possible loss to the country through the diminution of the business of the State and more particularly the port of New York.

It would be against human nature to expect that the business men of New York would urge any scheme which would reduce the importance of their city, even though the nation might possibly benefit thereby. Future economic results are too intangible to weigh very heavily in any argument of general as against personal good. So the New York opposition must be overcome, not by pointing out how the country needs the St. Lawrence waterway, but by convincing the timid New Yorker of the impregnable position of his city and port provided that port is kept up to date. There is in the metropolis a curious combination of fear and reaction. There are always listeners to any Cassandra who sees competition destructive of the city's greatness, but these same credulous souls continue to stand fast against any improvement of port or transportation facilities which could forestall such competition. New York, a year-round port fed by the great railroad systems of the nation, blest by a magnificent basin of deep and still water at its very warehouse doors, has nothing to fear from a St. Lawrence waterway unless shortsightedness and self-interest manage to prevent the development of the port as a unit without regard to state or city boundaries.

Only preliminaries of the St. Lawrence project will be brought forward for some time. The history of such schemes shows that many years are necessary for the education of the interests involved, but throughout the promotion of the plan there must be kept in mind the two facts noted above—first, that transportation is a national, in fact, an international problem, and that neglect of our great water powers is becoming more and more an economic crime.

New Studies of Railway Track: Counterbalance Effect and Behavior of Tie and Ballast

Second Report of Track-Stress Committee—Locomotive Unbalance May Double or Triple the Static Rail Stresses—Tie Bending as Related to Tamping—Distribution of Ballast Pressures

FUNDAMENTALLY important additions to existing knowledge of railway-track mechanics were made in the second part of the work of the committee on Stresses in Railway Track, a joint committee of the American Society of Civil Engineers and the American Railway Engineering Association. They are detailed in the committee's second progress report, about to be issued. In connection with the first report (abstracted in *Engineering News-Record* of Mar. 14, 1918, pp. 517-522) it places the subject of track on a basis of

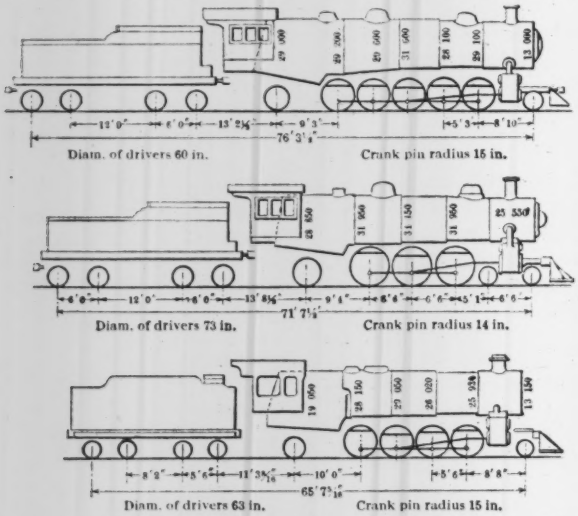

Diam. of drivers 60 in.
Crank pin radius 15 in.
Diam. of drivers 73 in.
Crank pin radius 14 in.
Diam. of drivers 63 in.
Crank pin radius 15 in.

FIG. 1. SANTA FÉ, PACIFIC AND MIKADO LOCOMOTIVES USED IN TESTS OF COUNTERBALANCE EFFECT ON RAIL STRESS
(Figures over wheels give single wheel-loads in pounds)

measured fact and verified theory so far as vertical actions on the rail are concerned.

With respect to the rail, rather serious conditions are revealed by the new investigations. The action of the driving-wheel counterbalance was found to multiply the static load stresses in the rail. With respect to the tie, the nature of the service given by the tie is —for the first time—defined by measurements of tie bending and distribution of the rail load to the ballast. Finally, how and in what proportions the ballast distributes the load to the subgrade is shown by the results of precise pressure measurements, satisfactorily correlated with the principles of ballast action.

It may be recalled that the first report led to important practical conclusions: The stress in the rail under a train or any other load is determined by the general track depression, with little regard to tie spacing. The roadbed acts as an elastic structure, except for a certain looseness or play absorbed in the first stage of the depression. Heavy rail, hard ballast (e.g., stone as compared with cinders), and deep ballast make stronger track, by reducing the track depression. Thorough tamping of track also reduces depression and rail stress. Besides these fundamental facts it was found that a train produces larger stresses when running at speed than when standing, and though the increase could not then be measured satisfactorily it was seen to be of considerable amount. Transverse bending of the rail was observed, arising from conditions not fully explained; in some cases the ratio of stress in outer flange of the rail base to stress in inner flange was greater than 3 to 1. While the effect of speed on track stresses was observed, the effect of counterbalancing could not be discerned; this remained for the subsequent studies.

The investigations covered by the second report indicate that:

1. The unbalanced rotating masses at the several drivers of a locomotive subject the rail to excess vertical forces, often larger than the computed effects. In some cases the excess stress chargeable to the unbalance is much more than the static rail stress. Measured total stresses in the rail base as high as 45,000 to 55,000 lb. per sq.in. point to the serious importance of the subject. Badly balanced locomotives may cause dangerous rail stresses.

2. There is a large speed effect, distinct from the counterbalance effect. It is roughly proportional to the speed, and may equal or exceed one-half the static stress. The counterbalance effect equals or exceeds the speed effect, even in well-balanced locomotives.

3. Trailing and leading wheels often show variation in rail stress during the revolution of the driving wheels. This seems to be due to the effect of the locomotive frame in transmitting counterbalance-effect impulses.

4. Wheel loads are distributed to the several ties in the same ratios for large as for small loads. The depression of any tie is proportional to its load, except that there is an initial irregularity of deflection chargeable to soft bearing or to slight play between rail and

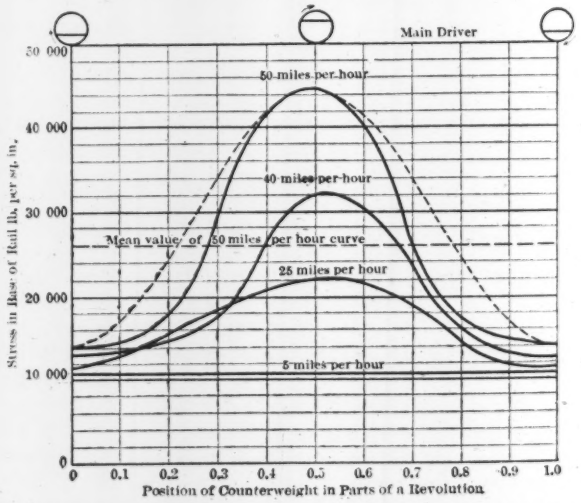

Main Driver
50 miles per hour
40 miles per hour
Mean value of 50 miles per hour curve
25 miles per hour
5 miles per hour
Stress in Base of Rail lb. per sq. in.
50 000
40 000
30 000
20 000
10 000
0
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Position of Counterweight in Parts of a Revolution

FIG. 2. STRESS VARIATION UNDER MAIN DRIVER DURING ONE REVOLUTION, SANTA FÉ LOCOMOTIVE
(Dotted line is line curve adjusted to high and low points of observed 50-mile curve)

ballast. The maximum tie-reaction under a four-wheel truck ranges from 13 to 16 per cent of the truck load, agreeing with theory.

5. Most track is distinctly centerbound before tamping. The endbound condition produced by tamping rapidly disappears. Yet the bending moment in the tie is greater directly under the rail than at midlength. The critical bending moments in the tie range from 2 to 6 pound-inches per pound of tie load, but should not exceed 2 to 2½ for first-class track well maintained.

6. Transmission of pressure in ballast follows laws deducible from theoretical considerations. At any level below the tie, the lateral distribution of load follows the "error curve." In this respect sand, gravel and broken-stone ballast behave alike. The pressure decreases downward according to an exponential or logarithmic law. The pressure of tie on ballast is greatest at the middle of the width of the tie and least at the edges, due to the friction between ballast and tie as the ballast tends to flow out laterally.

7. About 4 in. below the tie the ballast pressure is equal to or greater than that just at the tie. At 6-in. depth the load begins to spread, and at a depth equal to the tie spacing the pressure is nearly uniformly distributed.

Measurements of Counterbalance Effect

Three locomotives were used in the tests of counterbalance effect (Fig. 1.) The first, an engine of Santa Fé type, had caused considerable injury to the rail on the St. Louis-San Francisco R.R., presumably through extreme effect of bad counterbalance. In this locomotive it had not been found possible to put enough counterweight on the main driver, and therefore excess counterweight was put on the other drivers. The engine was practically balanced for rotating weight plus 60 per cent of reciprocating weight, except at the main driver where, even disregarding reciprocating weight, there was a deficiency of about 750 lb. For rotating weight alone the excesses and deficiencies of counterbalance required by rotating weight alone, were: +368 (first driver), +370, —746, +370, +368 lb. at crank-pin circle; and if the fact that the counterbalance and the rotating parts to be balanced are not in the same vertical plane be considered, the deficiency of 746 lb. for the main driver becomes 1,042.

For the second engine, Pacific type, the unbalance with respect to rotating masses amounted to +423, +330, and +428 lb. for the several drivers. Considering the leverage due to the weights being in different planes, the main driver had an overbalance of only 76 lb. In the Mikado engine, used on the Illinois Central R.R., the counterweight excess at each wheel was 263 lb. at crank-pin circle; with allowance for the non-planar relation of the weights, the main driver showed an underbalance of 15 lb.

For each pound of overbalance or underbalance at crank-pin circle the equivalent vertical-weight effects for the three locomotives are: Santa Fé at speed of 50 mi. per hr., 33.4 lb.; Pacific at 60 mi. per hr., 30.3 lb.; Mikado at 45 mi. per hr., 24.5 lb.

Tests were made by use of the stremmatograph previously described (see reference cited). Four instruments were used simultaneously, usually three on one rail and one on the opposite rail, but sometimes all four on one rail; they were placed about one driver-diameter apart so that for each instrument the counter-

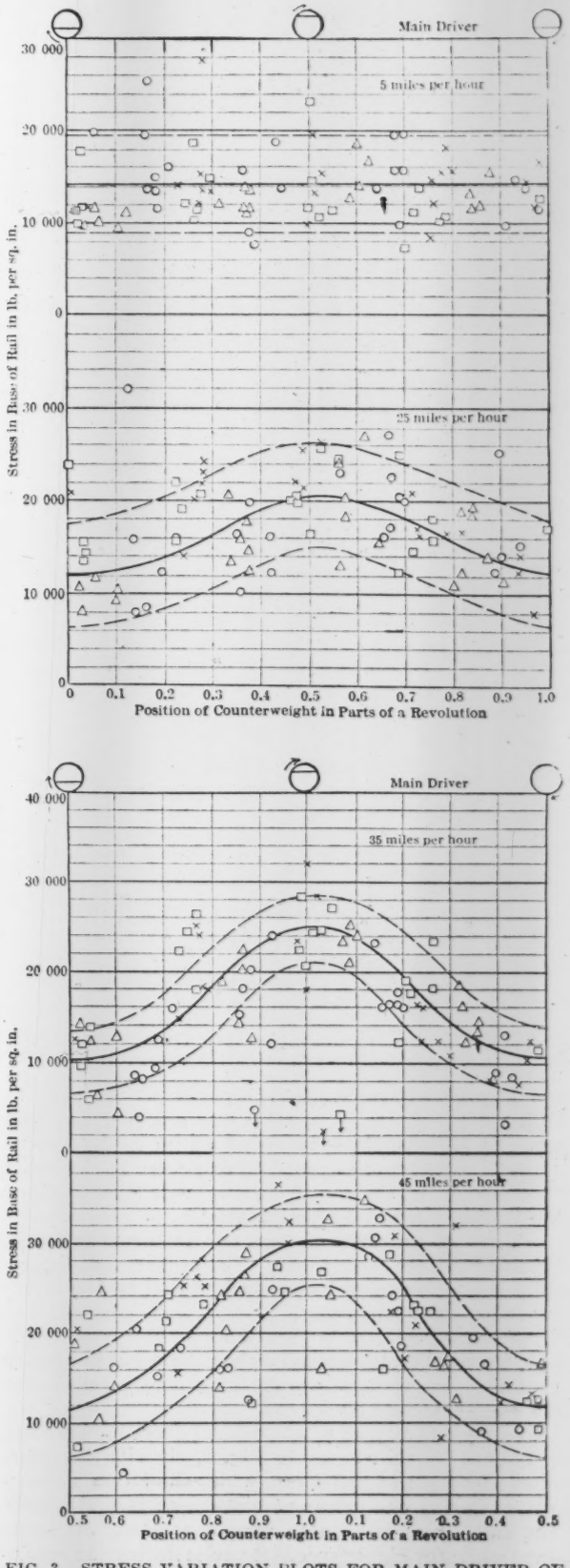

Main Driver
5 miles per hour
25 miles per hour
Stress in Base of Rail in lb. per sq. in.
30 000
20 000
10 000
0
Position of Counterweight in Parts of a Revolution
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Main Driver
35 miles per hour
45 miles per hour
Stress in Base of Rail in lb. per sq. in.
40 000
30 000
20 000
10 000
0
0.5 0.6 0.7 0.8 0.9 1.0 0.1 0.2 0.3 0.4 0.5
Position of Counterweight in Parts of a Revolution

FIG. 3. STRESS VARIATION PLOTS FOR MAIN DRIVER OF MIKADO LOCOMOTIVE
(The symbols represent different stremmatographs)

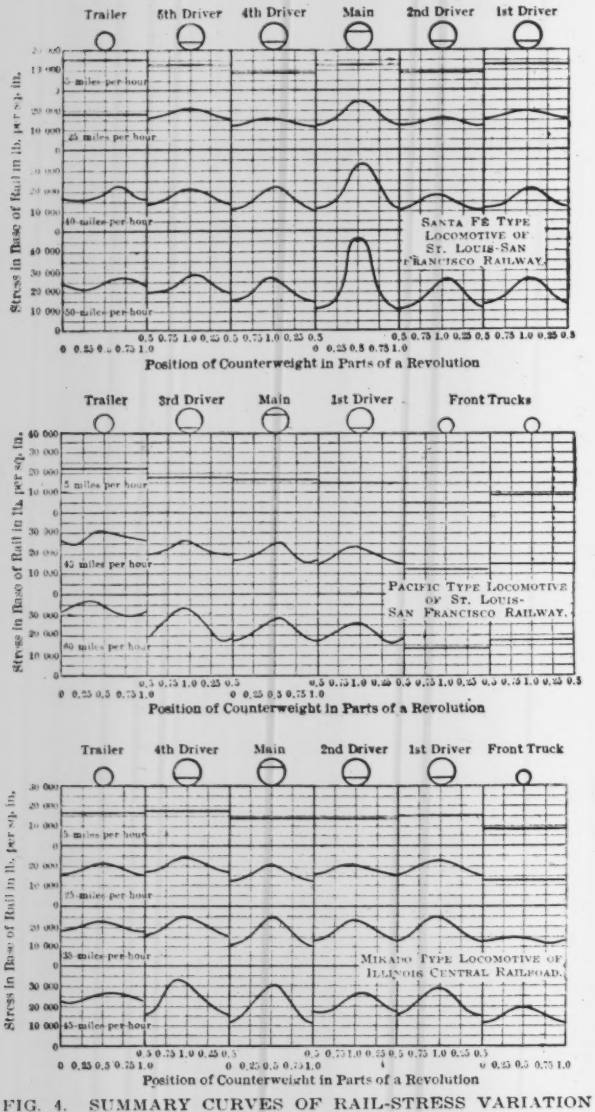

Trailer
5th Driver
4th Driver
Main
2nd Driver
1st Driver
Stress in Base of Rail in lb. per sq. in.
5 miles per hour
25 miles per hour
40 miles per hour
50 miles per hour
Santa Fé Type Locomotive of St. Louis-San Francisco Railway.
Position of Counterweight in Parts of a Revolution
Trailer
3rd Driver
Main
1st Driver
Front Trucks
Stress in Base of Rail in lb. per sq. in.
5 miles per hour
45 miles per hour
60 miles per hour
Pacific Type Locomotive of St. Louis-San Francisco Railway.
Position of Counterweight in Parts of a Revolution
Trailer
4th Driver
Main
2nd Driver
1st Driver
Front Truck
Stress in Base of Rail in lb. per sq. in.
5 miles per hour
25 miles per hour
35 miles per hour
45 miles per hour
Mikado Type Locomotive of Illinois Central Railroad.
Position of Counterweight in Parts of a Revolution

FIG. 4. SUMMARY CURVES OF RAIL-STRESS VARIATION FOR THREE TYPES OF LOCOMOTIVE

weight would have a different position. Its position with respect to one instrument was observed for each run. In all runs steam was shut off as the locomotive approached the test section. Speeds were read from a speedometer in the cab, connected with the tread of the trailer, checked by timing runs.

An immense amount of work was involved, as nearly 100,000 readings were made. The accuracy of the results is considered to be as good as that of the stress data previously reported.

All rail stresses given are those in the base of the rail; the head stress would be about 10 per cent greater (but the base stresses are determinative because here the lateral stresses are large).

The general nature of the results from all the tests is typified by the curves in Fig. 2, showing the measured variation of rail stress under the Santa Fé locomotive during one driver revolution, at several speeds. The rail stress is seen to remain constant at 5-mile speed while for higher speeds it varies during the revolution, approximately the theoretical sine-curve variation represented by the dotted line.

It is significant that the average rail stress for each of the curves is considerably above the static or 5-mile stress. A dashed line in the diagram represents the mean value of the 50-mile curve; the difference between this mean value and the 5-mile stress is the speed effect, while the difference between the maximum of the curve and the mean is considered as counterbalance effect. The ratio of the mean to the 5-mile stress is the "effect of speed" and the ratio of the difference between maximum and mean to the 5-mile stress is the "effect of counterbalance" tabulated in Tables I, II and III for the three engines tested.

Plots of individual test results for the Mikado engine, in Fig. 3, illustrate typically how the observations yield a well-defined sine-curve belt for each speed. The mean curve for each belt was obtained by averaging the values of the plotted points in groups for each twentieth of a revolution and drawing a curve through the resultant points.

Summary curves of rail-stress variation for all wheels of the three locomotives are given in Fig. 4. In the case of the Santa Fé engine, by far the greatest stress excess occurs under the main driver, due to the abnormal unbalance at these wheels. A remarkable feature of all three diagrams in Fig. 4 is that the trailer shows very considerable variations of stress during a revolution; since no unbalance of weight exists here, the variations must be due to variations of load transmitted by the frame and track. The track effect is taken account of in the "calculated" effect of counterbalance in the last line of Tables I, II and III. As these values do not agree well with the observed values, it seems probable that the influence of the locomotive frame is important.

The same is true of the stress variation under the front truck wheels of the Mikado at the higher speeds, though in the Pacific no such variation appears, even at 60 m.p.h.

How these effects vary with speed is shown in the upper diagram of Fig. 5, drawn for the Pacific engine. The speed and counterbalance effect here are separately plotted as ordinates, abscissas representing speed. It may be seen that both speed and counterbalance effect vary about in direct proportion to speed.

That the tender also exerts a very pronounced speed effect is indicated by the lower diagram of Fig. 5. The speed effect here clearly follows a linear law. The speed effects for drivers are "in general less than those for the tender wheels."

The committee concludes that "there is a decided advantage to the track in making the counterbalance of the several drivers differ but little from each other and from that condition which will give the best results, even though opposing conditions of counterbalance in the main driver and the adjoining drivers may have some neutralizing effect. An underbalance on one driver and on overbalance on an adjoining one will give a very undesirable cumulative effect." Further, "the uncertainty which may exist concerning exact conditions of counterbalance is a matter which warrants greater attention."

That the measured rail stresses were very high is shown by the following figures, taken from the high points of the mean curves: Santa Fé at speed of 50 m.p.h., trailer to leading truck, 27,000, 28,600, 26,500, 46,800, 25,500, 26,000, 15,600 lb. per sq.in. Pacific at speed of 60 m.p.h., 36,400, 34,800, 36,400, 26,000, 14,000,

18,700 lb. per sq.in. Mikado at speed of 45 m.p.h., 26,500, 32,800, 30,500, 26,500, 29,100, 19,600 lb. per sq.in. The committee points out that, because of the divergence of individual stress readings from the mean curves (see Fig. 3), values 6,000 to 8,000 lb. greater than these figures "may be expected not infrequently." And it further says, "The occurrence of stresses in base of rail (the average of the values at the two edges) as high as 52,000 lb. per sq.in. (and 10 per cent higher in head of rail), observed at high speeds in a number of cases where the records were well defined, shows that it is not strange that kinks and rail failures were produced in the regular service of these locomotives," of the Santa Fé type.

It was found by special tests that the Santa Fé engines produced stresses in the left-hand rail uniformly higher than those in the right-hand rail, by as much as 20 per cent. This was true at all speeds, and had no relation to either speed effect or counterbalance. No such differences occurred under the tender, however. Even previously, service results had indicated that injuries were more common in the rail on the left-hand

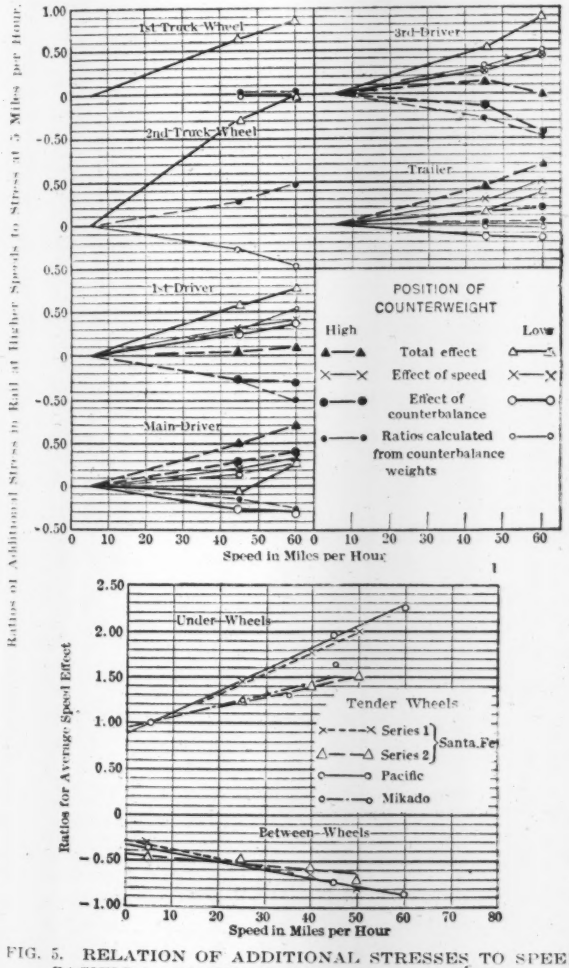


FIG. 5. RELATION OF ADDITIONAL STRESSES TO SPEED. PACIFIC LOCOMOTIVE AND THREE TENDERS

side, under locomotives of this type on the St. Louis-San Francisco R.R. No reason for this one-sided condition is known, the committee states.

That lateral bending of the rail occurs under locomotives was reported two years ago. In subsequent study it was found that this effect is not related to counterweight position or to speed, but that the average of stresses at the outer edge of the rail base for all the wheels ranged 20 per cent to 50 per cent higher than

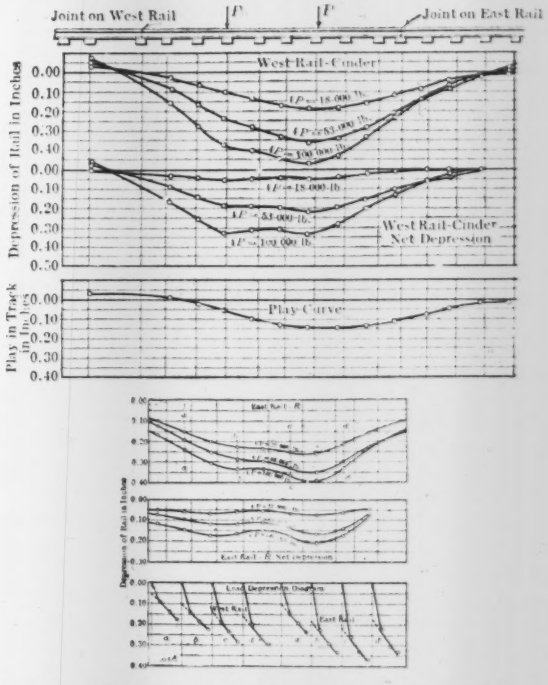


FIG. 6. TRACK DEPRESSIONS AT TWO LOCATIONS; INITIAL PLAY AND NET DEPRESSION
Cinder-Ballasted Track, Illinois Central R.R. Class B. Track, C. M. & St. P. Ry.

the average at the inner edge, or 9 to 20 per cent higher than the near base stress (to which all other figures given refer). The effect occurs even under flangeless drivers. Thus, it is apparent that lateral bending moments, which in some cases range up to 8 per cent of the vertical bending moment, are active. No further investigation has been made to determine the cause. The factors just noted all act to increase considerably the mean stresses heretofore cited.

Distribution of Load To Ties

New measurements of track depressions under known loads not only confirmed the prior deduction that track is elastic but also provided data for computing the load on the individual ties.

A leveling bar was used to measure the depressions, as described two years ago (see reference cited). Fig. 6 shows specimen plots of depressions under a four-wheel truck loaded to different total loads. When the depressions at any one point were plotted on a base of load, as in the lower part of Fig. 6, a straight line resulted, demonstrating elastic action; but in the early stage of the depressions there was a divergence from the straight line, indicating the equivalent of a slight looseness or play (0.02 to 0.18 in.) in the track before solid bearing was reached and elastic action began. Taking the amounts of play for different points along the track from these plots, a play curve was obtained (second diagram of Fig. 6). Deducting the amounts of play from the depressions, curves of net or elastic depression were obtained, one set of which is shown near the bottom of Fig. 6.

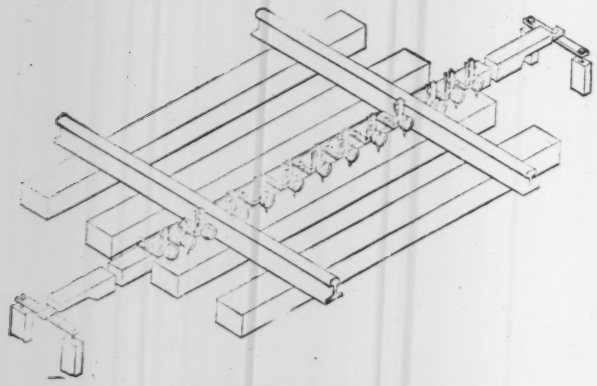


FIG. 7. BAR FOR MEASURING TIE-BENDING

From such net curves the depressions of all the ties affected were summed and equated to the total load. Simple division thus yielded the value of load required to depress one tie 1 in.; and this value multiplied by the depressions of the individual ties gave the loads borne by them.

Generally the load on a tie directly under an axle amounted to 13 to 16 per cent of the two-axle truck load; midway between wheels the tie reaction was as much as 1½ per cent more (see Table 4). Theory indicates 15 per cent under the wheel and 16 per cent midway between wheels for track of the properties of that tested.

Measurements of the flexure of the tie were considered the best means of studying tie action. A gage bar (Fig. 7) was supported on stakes at either side of the track, and thirteen Ames dials attached to the bar bore each on a track at the middle of the width of the tie. A two-axle truck (18,000 to 100,000 lb. load) was placed on the track so that the leading axle was directly over the tie under test; the heaviest load used gave

TABLES I AND III COUNTERBALANCE EFFECTS AND SPEED EFFECT FOR THREE LOCOMOTIVES

Ratios of rail stress under wheel at high speed to rail stress at 5 m.p.h.
Speed effect is ratio of mean stress during revolution at high speed to constant 5-mile stress. Counterbalance effect is ratio of difference between high-speed maximum (or minimum) stress and mean stress to 5-mile stress. The sum of the two is the total effect, or ratio of maximum rail-base stress at the given speed to the 5-mile stress.

TABLE I. SANTA FE ENGINE, SPEED 50 M.P.H.

	Trailer	Driver 5	Driver 4	Driver Main	Driver 2	Driver 1	Truck Wheel
Calculated counterbalance stress in rail base at 50 m.p.h.; lb. per sq.in.	600	8,100	11,400	24,200	11,300	8,100	700
Effect of speed	1.58	1.82	1.98	1.92	1.83	1.53	
Effect of counterbalance:							1.97
Counterweight up	+0.20	—0.30	—0.40	+1.83	—0.66	—0.45	
Counterweight down	—0.20	+0.43	+0.79	—1.00	+0.77	+0.55	
Calculated counterbalance effect	0.03	0.51	0.91	1.74	1.01	0.48	0.08

TABLE II. PACIFIC ENGINE, SPEED 60 M.P.H.

	Trailer	Driver 3	Driver Main	Driver 1	Truck 2	Wheel 1
Calculated static stress in rail base; lb. per sq.in.	23,500	17,300	17,100	16,400	4,400	9,100
Calculated counterbalance stress at 60 m.p.h.; lb. per sq.in.	700	8,700	4,400	8,500	2,100	100
Effect of speed	1.50	1.44	1.32	1.41		
Effect of counterbalance:						
Counterweight up	+0.19	—0.45	+0.38	—0.31	2.48	1.85
Counterweight down	—0.15	+0.44	—0.30	+0.36		
Calculated counterbalance effect	0.03	0.50	0.26	0.52	0.48	0.01

TABLE III. MIKADO ENGINE, SPEED 45 M.P.H.

	Trailer	Driver 4	Driver Main	Driver 2	Driver 1	Truck Wheel
Calculated static stress in rail base; lb. per sq.in.	16,300	18,200	15,300	12,500	16,500	9,600
Calculated counterbalance stress at 45 m.p.h.	200	4,200	3,200	3,200	4,300	400
Effect of speed	1.53	1.46	1.47	1.49	1.41	1.81
Effect of counterbalance:						
Counterweight up	+0.15	—0.51	+0.67	—0.34	—0.41	+0.48
Counterweight down	—1.18	+0.53	—0.55	+0.37	+0.45	—0.47
Calculated counterbalance effect	0.01	0.24	0.21	0.26	0.26	0.05

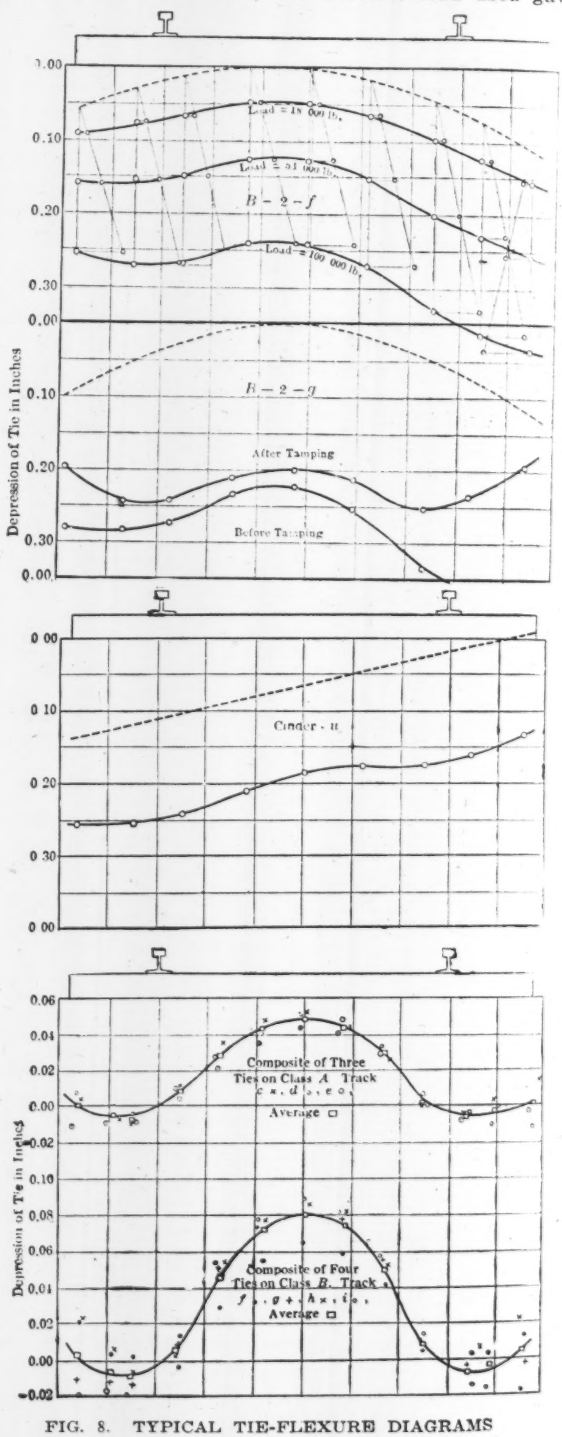

Depression of Tie in Inches
Load = 18,000 lb.
Load = 53,000 lb.
Load = 100,000 lb.
B – 2 – f
B – 2 – g
After Tamping
Before Tamping
Cinder - u
Composite of Three Ties on Class A Track
c ×, d ○, e □
Average □
Composite of Four Ties on Class B Track
f ○, g +, h ×, i □,
Average □

FIG. 8. TYPICAL TIE-FLEXURE DIAGRAMS

Upper: 85-lb. rail, 6 x 8-in. oak ties, 12-in. stone ballast; ties *f* and *g* located one tie apart.
Middle: 85-lb. rail, hewn oak ties, 12-in. cinder ballast; freight lead track.
Lower: Composite diagrams of net deflections.

a tie reaction "considerably less than that which would be caused at and between drivers by an ordinary Mikado or Santa Fé type locomotive." The ties sawed ranged from 7 x 8 in. x 8½ ft. to 6 x 8 in. x 8 ft.

Many curves of tie flexure were obtained, of which Fig. 8 gives examples. The upper part of the upper diagram shows how the several bending curves on any given tie were utilized for determining the "play" or looseness of the tie. At various points along the bending curve the loads for the respective curves were plotted as abscissas, with the deflections as ordinates, and load-deflection curves (just like those of Fig. 6) drawn as straight lines through the resulting points; the zero points of these load-deflection lines were taken to represent the initial solid bearing. By this means the dotted lines shown in Fig. 8 above the observed tie-flexure curves were obtained, these dotted lines representing in effect the profile of the tie at the moment it reached solid bearing.

TABLE IV. TIE REACTIONS IN TERMS OF LOAD ON FOUR-WHEEL TRUCK

(Typical results of tests on C. M. & St. P. Ry., for 7½-in. ties on 36-in. gravel ballast. First three lines refer to main-line track with 100-lb. rail; last two lines to branch-line track with 75-lb. rail.)

Tie 1	Tie 2	Tie 3	Tie 4 (Under Wheel)	Tie 5	Tie 6	Tie 7 (Under Wheel)	Tie 8	Tie 9	Tie 10
0.07	0.09	0.10	0.11	0.11	0.11	0.11	0.12	0.10	0.08
0.04	0.08	0.11	0.13	0.13	0.13	0.13	0.11	0.09	0.05
0.04	0.07	0.11	0.14	0.14	0.14	0.13	0.11	0.08	0.03
0.07	0.09	0.11	0.11	0.10	0.11	0.14	0.12	0.08	0.05
0.06	0.09	0.13	0.14	0.13	0.13	0.12	0.10	0.06	0.03

Net deflections, reckoned from the curves of solid bearing, were plotted in the two composite tie-flexure curves constituting the lower diagram of Fig. 8. These represent first-class track and second-class track on the Chicago, Milwaukee & St. Paul Ry. It will be seen that the net deflections showed fairly similar action in different ties, though the gross deflections varied greatly.

From the flexure curves, the bending moments in the ties were computed, based on average moduli of elasticity found by bending tests of ties in a testing machine (oak ties, 1,250,000 lb. per sq.in.; soft-wood ties, 800,000). Specimen results are given in Table V. The committee concluded that *in first-class track* a center moment of 2W and a reverse moment at the center of 1W is to be expected; and a moment under the rail of 2.5W. The observed values are greater, probably in part because of the crushing or excessive depression of the wood at the rail; but as this action weakens the tie under the rail, the higher values should be used for wood ties.

Comparing the bending moments with those that would result from various distributions of bearing pressure on the lower face of the tie, the committee con-

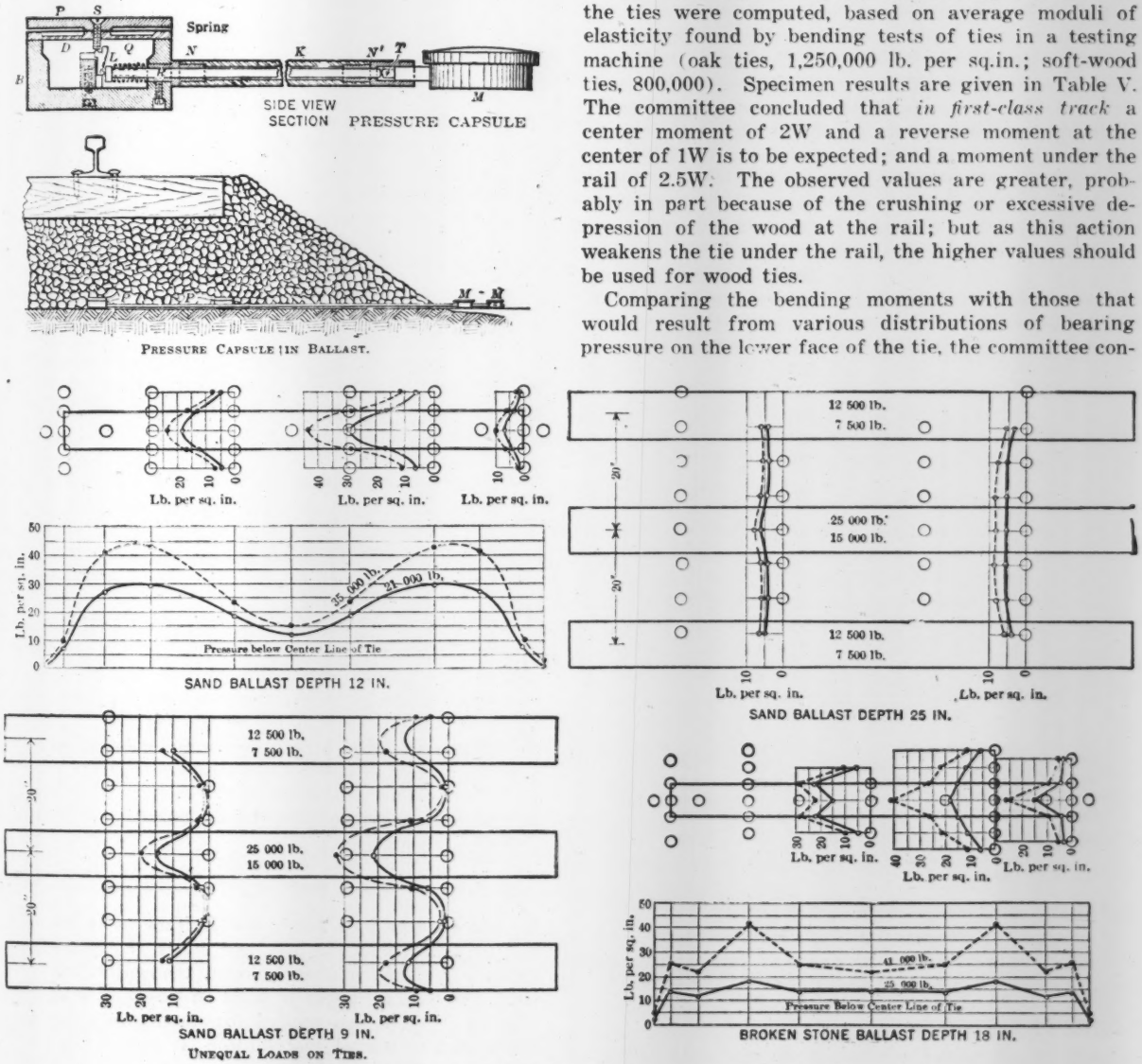


FIG. 9. PRESSURE CAPSULE AND PLOTS OF BALLAST PRESSURES

First diagram shows pressures under single tie load through 12 in. of sand ballast. Second and third diagrams are for three-tie group, unequally loaded, through two depths of ballast. Fourth diagram is for single tie load on broken-stone ballast. Small circles show location of pressure capsules.

cludes that "the maximum bearing pressure per unit of length of tie, under static loading, will not ordinarily exceed twice the average bearing pressure over the length of the tie; and for track in good condition the maximum will be less than 1½ times the average."

Pressures in Ballast

To measure the pressures in the ballast at various depths below the tie, gages or "pressure capsules" as sketched in the upper part of Fig. 9 were constructed. In the gage, the deflection of a steel diaphragm plate protected by a faceplate is measured by a small lever whose motion is transmitted to the plunger of an indicating-dial micrometer. The faceplate has an exposed area of 5 sq.in. Friction tape wrapped around the case prevents sand and dirt from entering between the faceplate and the diaphragm; each capsule was calibrated after being taped.

The test rig consisted of a reinforced-concrete slab 16 x 19 ft., 12 in. thick, on which the ballast was carried, and over this slab a reaction frame anchored to the slab by the tie-rods, to serve as abutment for a jack by which loads could be applied to one or more ties resting on the ballast. The jack load was measured by a calibrated steel spring. Many pressure capsules were used in each test.

From theoretical consideration of the manner in which a load is transmitted down through a granular mass, where each grain bears on two or more grains below and distributes its load among them, the committee concluded that at any horizontal plane in the ballast the vertical pressures are distributed laterally in proportion to the ordinates of a probability or error curve, which curve spreads out wider and has a lower middle ordinate (lower maximum pressure) as the depth below the concentrated load is increased. This is true only for the distribution of a load in two opposite directions, not radially in all directions from a point; it applies approximately to the distribution of load through the ballast from a tie.

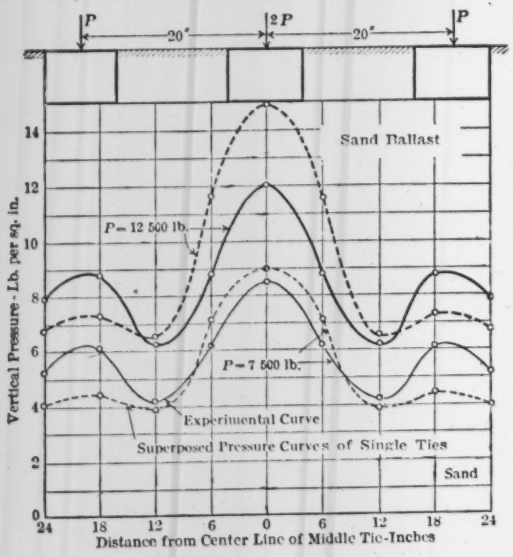


FIG. 10. DISTRIBUTION OF BALLAST PRESSURE UNDER THREE TIES, COMPARED WITH SUPERIMPOSED CURVES OF SINGLE-TIE RESULTS

Measured pressures obtained with the apparatus described confirm this deduction in very satisfactory manner. A number of pressure curves are grouped in Fig. 9, and from the single-tie test represented by the first of the diagrams it will be seen that the distribution of pressure laterally follows a law very similar to the probability law. Comparing the second and third diagrams of Fig. 9, it is also seen how the pressure distribution flattens out with increasing depths below tie. The effect of several ties whose zones of influence overlap is closely in agreement with a curve obtained by adding the separate effects of the individual ties (Fig. 10). In stone ballast the pressure distribution is somewhat less regular than in fine ballast (see last diagram in Fig. 9), but the same general laws are evidently effective. In one test the pressure directly at the bottom face of the tie was measured, by embedding the capsules in the lower face of the tie, with the pressure plate flush with bottom of tie. The results were similar to those measured at some depth below the tie.

TABLE V. BENDING MOMENTS IN TIES

(From tests on C. M. & St. P. Ry. values in pound-inches when W is total load carried by one tie, in pounds.)

	Moment at Center of Tie	Moment Under Rail
Class A Track:		
Maximum	—4.5W	+6.0W
Minimum	—0.8W	+3.2W
Average	—2.5W	+5.0W
Class B Track:		
Maximum	—2.1W	+3.7W
Minimum	—0.9W	+2.3W
Average	—1.5W	+3.3W

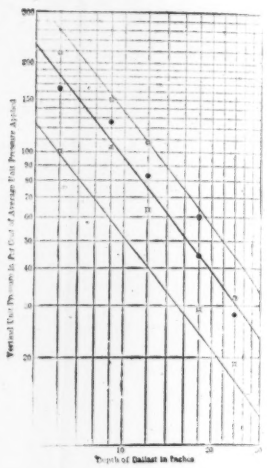


FIG. 11. VARIATION OF BALLAST PRESSURE WITH DEPTH

The committee concludes that "the laws of distribution of pressure through ballast (noncohesive granular material) are practically the same for the various kinds of ballast."

Variation of ballast pressure with depth is summarized in the logarithmic diagram Fig. 11, the points for which were taken from the averaged pressure curves of the experiments. Here the ordinates represent pressures at various depths below the center line of the tie, expressed as the percentage of the average pressure over the bottom of the tie; the abscissas represent depth of ballast. The maximum and minimum observed intensities of pressure have been plotted. A straight line whose equation is

$$p_c = \frac{16.8 p_a}{h^{1.25}}$$

fits the observations fairly well. Here p_a is the average pressure over the tie, and p_c is the pressure at depth h (in inches) directly below the center line of the tie. The data all apply to tests on ties 8 in. wide. Using the formula just quoted for maximum pressure at depth h, the lateral distribution at this depth is expressed by the formula

$$p = \frac{16.8 p_a}{h^{1.25}} 10^{-6.05 \times 2/h^{2.6}}$$

This formula, applying to depths from 4 in. to 30 in. below bottom of tie, agrees well with the test results.

From the test data contours of equal vertical unit pressures in ballast were drawn, as reproduced in Fig. 12. It is concluded from these that "in general the vertical pressures become nearly constant at a depth equal to the tie spacing." As to this point the third diagram in Fig. 9 is pertinent.

From reasoning based on the effect of friction between the bottom of the tie and the ballast tending to crowd out from under the tie while the latter is being forced down in the ballast by its load, it was concluded that "there is a concentration of pressure a short distance below the tie, say at 3 to 4 in., and the intensity of pressure in the ballast at such a depth is greater than exists at the bottom of the tie. For the tie of ordinary width the intensity of pressure at a depth of 6 in. and the distribution of vertical pressure over a

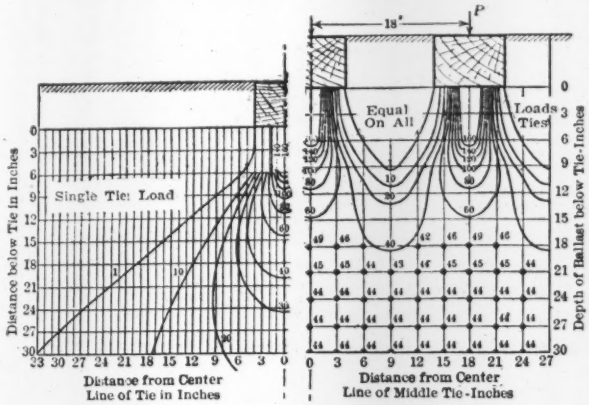


FIG. 12. LINES OF EQUAL VERTICAL PRESSURES IN BALLAST

(Curves drawn from measured pressures with help of theoretical formulas for distribution.)

horizontal plane at this depth do not differ greatly from those existing immediately under the tie. The directions of the pressures are not the same. At or below this depth the distribution of pressure laterally begins." Further, "for the ordinary width of tie the effect of the pressure transmitted from the adjacent tie to points midway between ties (overlapping lines of pressure) is noticeable at a depth equal to about half of the usual tie spacing. At a depth of three-fourths of the ordinary tie spacing the pressure immediately under the center of the tie is about 1½ times that resulting from a uniform distribution over the horizontal plane. At a depth equal to the ordinary tie spacing the lateral distribution has become such that the variation in intensity of pressure from tie to tie is small. The variation in intensity of pressure in the ballast lengthwise of the tie becomes less and less with increase in depth and it may be expected that the variations will be smoothed out at a depth equal to the ordinary tie spacing or a few inches below, where there will be a fairly uniform pressure over the horizontal plane."

However, the report observes, "it seems probable that the effect of the jarring action of the train loads will be to decrease the lateral distribution of pressure. It seems possible also that this tendency is counteracted in some degree by the cohesion which develops in ballast after it has been in place for some time." The committee also points out the favorable effect of ballast above the bottom of the tie, especially near the ends of the tie, increasing the ultimate carrying capacity of ballast under jarring and vibratory loads (but not under static loads), especially at the end of the tie, where the whipping action on the tie more easily pushes the particles of ballast away.

Prof. A. N. Talbot, of the University of Illinois, heads the committee and has been in direct charge of the field and laboratory work and the interpretation of results. The principal men engaged in the tests were H. R. Thomas and N. E. Ensign, who conducted the field tests, Prof. M. L. Enger, who did the experimental work on transmission of pressure in ballast, and E. E. Cress.

The Road Problem in England

Regarding the road and traffic problem in England the Engineering Supplement of the *Times* (London) prints the following in its annual review number, January, 1920:

"Designers of motor and steam lorries are faced with the task of producing a mechanically propelled vehicle the weight of which in relation to carrying capacity shall be lower than of the types now in service, and which preferably shall take a large load. This raises questions as to permissible weights per axle, and introduces the road problem in a somewhat acute form. It implies not only the reconstruction of all existing first and second class roads to meet these traffic conditions, but the construction of a large mileage of new roads, specially designed for mechanically propelled traffic moving at speeds in excess of those whch are permissible on existing roads.

"The Ministry of Transport, which has established a Roads Department and placed it in charge of a road engineer of recognized ability, is giving attention to the subject, and is now engaged in the work of classifying roads as a preliminary to framing a comprehensive scheme of reconstruction and new roads. The recent conference of road authorities in London served to focus attention on all parts of the road problem, engineering, financial, and administrative, and an attempt was at the same time made to indicate the lines of progress in the design of road vehicles to meet the needs of the new transport era. The spirit of co-operation between road authorities, manufacturers of lorries, and road users which the conference aroused should materially aid the work which is being undertaken by the Ministry of Transport.

"The ability of the road motor to compete on equal terms with the railway for goods transport, even for short hauls—the economic limits of distance have yet to be definitely determined—depends in the last resort, even when the road and motor engineer have fulfilled their part of the work, on the price of fuel. That of solid fuels is increasing, and was partly responsible, in conjunction with wage demands, for the withdrawal of the steam omnibus from the London services. The price of liquid fuels used in the internal combustion engine also tends to rise. New fuels are being experimented with, and without accepting the exaggerated claims which are sometimes made in this connection, there is good ground for hope that the introduction of alternatives to gasoline or parafin may serve to steady the market for those oils and prevent an undue hanidcap from being placed on road transport."

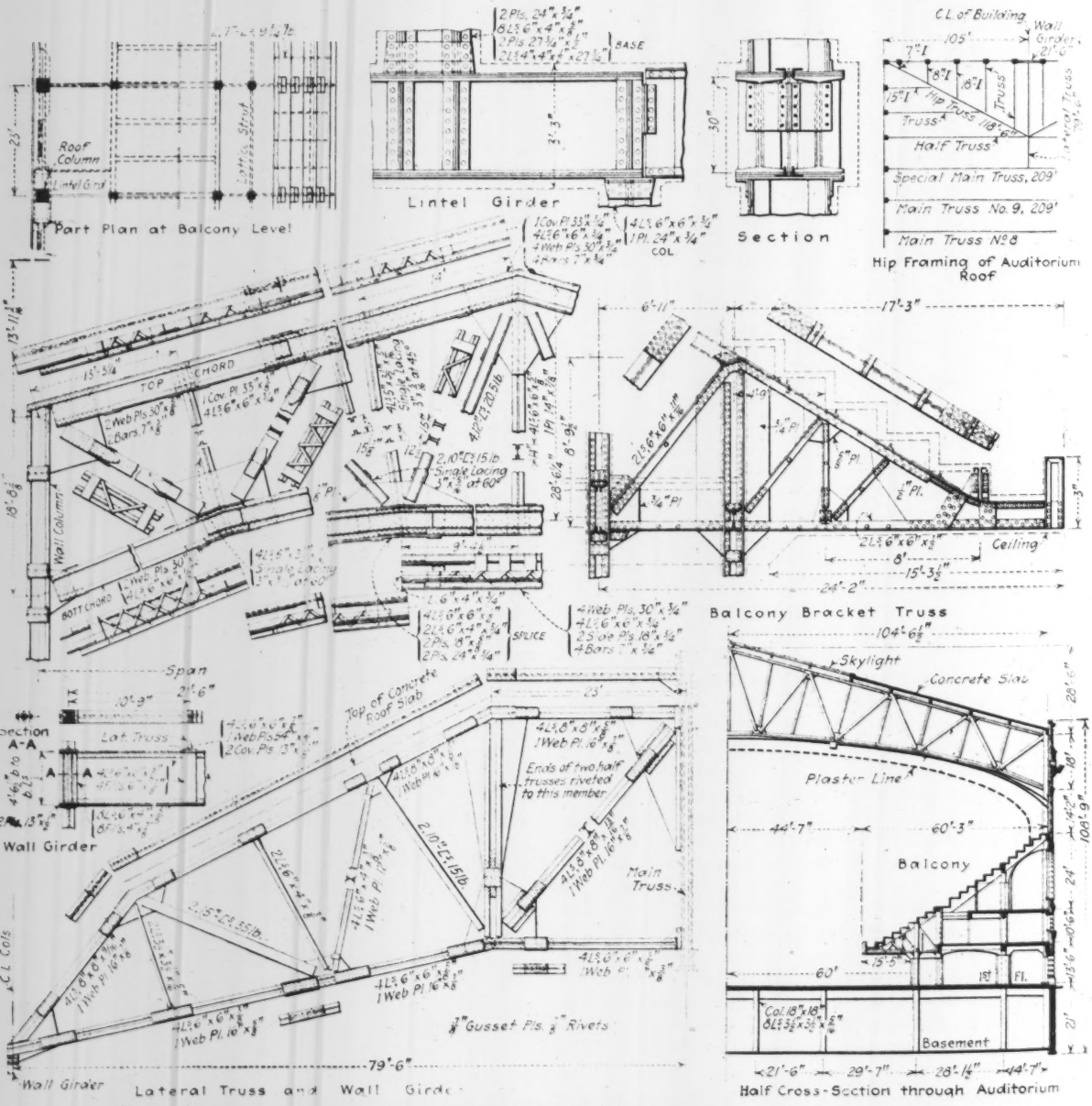
Steel Framing for Public Hall in Cleveland

Special Roof Design to Suit Architectural Plans—Lintels Carry Columns—Cantilever Trusses for Balcony

AN UNUSUAL arrangement of steel trusses for hip-roof framing over an auditorium has been designed for the north end of the new Public Hall in Cleveland, Ohio, in order to avoid placing large columns at points where they would encroach upon the inclines which take the place of stairways between the floors, and at the same time to meet the roof lines chosen by the architect. The auditorium is very large, being capable of seating 12,000 (stage included), so that it necessitates heavy and costly roof framing. Its trusses are among the largest simple roof trusses on record. The arrangement of the trusses and roof bracing is shown on the accompanying plan.

Normally, the end lateral truss and diagonal hip trusses would be carried by the first main transverse truss. In the Cleveland building, however, the columns for this panel must be narrow enough to clear the inclines noted above, while in view of the extra load it was considered desirable to carry this load on columns extending directly to foundation footings. To meet these conditions, the plan adopted was to extend the lateral truss back to what ordinarily would be the second main truss, as this is supported by columns extending down to the foundations. The place of the first main truss is taken by two half trusses which are framed into the lateral truss, the two hip trusses being framed into the same connection.

In the general layout of the roof framing, the southern part of the building is spanned by ten trusses 21'



SPECIAL STRUCTURAL ELEMENTS OF MUNICIPAL AUDITORIUM, CLEVELAND, NOW UNDER ERECTION

ft. long over all or 209 ft. 1 in. between centers of supporting columns. These are spaced 23 ft. on centers. From the middle of the first truss, the 79½-ft. lateral truss extends to the north wall, where it is seated on a plate-girder of 21½-ft. span, carried by two of the wall columns. From the first panel point of the lateral truss two hip trusses 118½ ft. long extend diagonally to the corners of the building and two half trusses extend to the side walls, the ends of their chords being framed against the truss post.

The hip trusses carry short trusses having their outer ends riveted to columns in the side and end walls. Between the trusses is a framing of I-beams and channels to support the 5-in. concrete roof slab. Diagonal bracing of rods is used in some of the panels.

The last main 213-ft. truss at the north end, which carries the lateral truss, is of very reavy design, having deep double-web chords, with cover plates over the entire upper side of the top chord. The posts are of I-section, composed of four angles and single lacing and extending through the chords. Each of the heavier diagonals has a pair of I-section members composed of two channels riveted against a web plate, the two members being connected by batten plates and lacing. The lighter diagonals are pairs of channels, with lacing. The other main trusses are of similar but lighter design, with each chord composed of two T-shaped members having a web plate and two flange angles. The lateral truss is shown also, together with the wall girder which carries its outer end. The hip trusses have T-section chords with deep webs in the top chord panels where connections are made with the short trusses extending to the walls.

The wall columns, which have an essential relation to the lateral rigidity of the structure, are of box section, having two web plates and eight flange angles with batten plates over the flanges. They are carried up to the elevation of the top chords and the trusses are framed between them, thus making the substantial connection which is necessary for the lateral stiffness for the roof. Several of the wall columns are supported on lintels or wall girders 10 ft. 4 in. long, at the second-floor level. This is owing to the different spacing of the columns below, as governed by the architectural design. Each of these lintels is composed of a pair of 30-in. I-beams with top and bottom cover plates and is reinforced by stiffeners under the shoe of the upper column.

Cantilever trusses of triangular form, carried by two rows of interior columns, serve to extend the balconies about 15½ ft. over the main floor, as shown in the cross-section of the building. Shallow plate and lattice girders are used extensively in the floor framing, which supports a concrete slab. The column foundations are concrete footings extended down to soil of satisfactory bearing power.

The steelwork weighs 4050 tons, of which 1650 tons are in the roof framing. The total represents a weight of 101 lb. per square foot of the building and 0.95 lb. per cubic foot of the building. Including the ceiling weight, the dead load of the roof is 150 lb. per square foot; suspended loads also are provided for. The live load due to wind and snow is taken as 35 lb. per square foot. For the main portion of the first floor a live-load of 2550 lb. per square foot was taken, and for the upper floors a live-load of 80 lb. Unit stresses conforming to the city's building code were used in the design. The steelwork s left unpainted, as it is to be cased in concrete.

Construction work was stopped for a time during the war, but has been resumed. At the end of June, 1919, the erection of the structural steel for the stage section of the building had been practically completed, and the erector was moving northward in readiness to place the first of the 213-ft. roof trusses. These large trusses are being assembled, fitted and reamed at the shops in the same manner as railway bridge work is handled. The basement walls are progressing as fast as the steel erection. It is expected that the erection of structural steel will be completed by October. This will be followed by the contract for the reinforced-concrete work and the exterior walls, so it is hoped to have the building under cover by the end of 1920.

The cost of this municipal hall is estimated at $2,000,000, which sum has been provided for by a bond issue approved by public vote in 1916. It will be 590 x 213 ft. in all. The part now under construction, forming the central portion, has its main floor, 120 x 257 ft., at the street level, while on three sides are balconies 60 ft. wide extending from the walls and having a cantilever projection of 15½ ft. over the floor area. Offices, corridors and balcony entrances are arranged on two narrow upper floors beneath the sloping floor of the balcony.

This large municipal structure was designed by F. H. Betz, city architect, and F. R. Walker, consulting architect. The structural design was prepared by the Osborn Engineering Co., acting as consulting engineers. The contractor for the foundation work was the Hunkin-Conkey Construction Co., and the Cleveland Fireproof Construction Co. is at work on a contract for the basement walls. The King Bridge Co. has the contract for the steelwork, including erection.

Lead Substitute Experience in St. Louis

TRIAL of the lead substitute metalium for pipe joints on a 6-in. line with 96 joints are given in the annual report of the St. Louis Water Department as follows: The trench was left open for two weeks. The leakage immediately after filling amounted to 2½ gal. per minute, the average over the first 24 hours was 1½ gal. per minute, over the second 1.15 gal. per minute, which in the course of two weeks gradually diminished to an amount too small to be registered by the meter, although still making itself evident as a dampness around the joints.

The report states that although this material requires no calking there is not as great a saving as might be imagined, since the services of one man are required almost constantly at the melting pot due to the comparatively small range of pouring temperature as compared with lead. Considering this, together with the fact that a special unoiled jute at 16c. per pound is required for metalium joints as compared with standard jute at 8c. for lead, the cost per joint proved to be greater than the average cost of 6-in. lead joints, figuring lead at 5c. per pound. While greater familiarity with the material would undoubtedly lower the cost per joint, L. Chivvis, engineer in charge of distribution, concludes that it is problematical whether the margin would be great enough to justify abandoning a material with which the organization is exceptionally skillful and which is reliable beyond a doubt.

Proposed Concrete Incased Steel Arch of 340-Ft. Span

Oregon Highway Department Will Probably Use This Design as New Crossing of Willamette River

STUDIES now being made by the Oregon State Highway Department for a new bridge across the Willamette River at Oregon City contemplate the use of a central 340-ft. arch of steel incased in concrete. One of the preliminary sketches of the structure is given in the accompanying drawing.

The main channel span, which has a rise of 100 ft. is flanked by reinforced-concrete viaduct approaches, the entire structure being about 860 ft. in length. The roadway is half suspended and half supported and crosses the channel on a 5 per cent grade, this grade being unavoidable by reason of a street intersection on the lower end and a railroad crossing at the higher. It would be impossible at any reasonable cost to provide a subway crossing and even if this were done, navigation clearance requirements eliminate the possibility of materially lowering the grade at the center of span.

The main arch span consists of two ribs of the box-girder type, with two ½-in. web plates, eight 6 x 6 x ⅝-in. flange angles and four 14 x ¾-in. cover plates. The box section is latticed top and bottom and stiffened at the center with a latticed diaphram; the ribs are 4 ft. wide, 7 ft. deep at the crown and 11½ ft. deep at the spring line, and all steelwork is entirely incased in concrete. In order to reduce the dead load, the concrete incasement is to be made hollow, and a study of light-weight concrete in this connection is being made by the department at the present time.

The water in the channel at this point is over 100 ft. deep, for which reason falsework is completely out of the question, and it is therefore planned to erect the steel ribs as three-hinged arches and suspend the falsework for the concrete incasement from the same.

The designs are being studied under the direction of C. B. McCullough, bridge engineer. Herbert Nunn is State Highway Engineer.

Summary of Contract Terms for Garbage Feeding at Three Cities

A COMPARISON of the terms of the contracts under which the groups of Baltimore, Md., Newark, N. J., and Buffalo, N. Y., is being disposed of by feeding to hogs is shown by the accompanying table. The table was included in the report of the Committee on Refuse Collection and Disposal submitted to the Sanitary Engineering Section of the American Public Health Association at New Orleans the last week in October, 1919. E. D. Rich, engineer Michigan State Board of Health, is chairman of the committee.

COMPARISON OF CONTRACTS FOR GARBAGE DISPOSAL BY FEEDING TO HOGS AT BALTIMORE, NEWARK AND BUFFALO

Location	Estimated Population	Area, Sq. Mi.	Contract Effective, 1919	Duration of Contract, Years	Price per Ton Paid by Contractor	Collection and Delivery	Separation	Material Included	Estimated Daily Collection, Tons	Estimated Number of Hogs	Housing of Hogs	Feeding Facilities	Reduction Considered?	Previous Arrangement
Baltimore, Md.	720,000	80 5	1919 May 1	4½	3½ times top price per lb. live killing hogs at Chicago. Garbage drained before weighing.	City collects and delivers 16 miles by barges to piggery.	To be enforced.	Household garbage and animal market refuse.	140 tons	15,000	Shaded yards, 70 ft. by 250 ft., 100 hogs each.	Concrete feeding floors. Garbage unloaded and spread by machinery each day.	Yes. Bids asked but none received.	Reduction cost $1.06 per ton. Temporary burial cost 85c. per ton.
Newark, N. J.	450,000	23	1919 July 3	5	8 times top price per lb. Chicago killing hogs.	City collects and delivers to piggery.	To be enforced.	To be attempted.	100 tons	5000 in summer.	Unit buildings 100 ft. sq. 80 to 100 hogs each. Sawtooth roof. Windows, top and sides.	Double concrete driveway and feeding floor, 24 ft. wide through center each building. Gutters on each outer edge next to pens. Pens slope to gutters. Yard 50 ft. deep for each pen.	Yes, but cost too much. $750,000 exclusive of land.	Combined refuse dumped. $3000 realized annually from salvage.
Buffalo, N. Y.	.....		1919 Oct. 1	5	Minimum, 50c. per ton; 6, 7, or 8 times Chicago hog price according to amount of garbage.	City collects and delivers to feeding platforms.	To be enforced.	.....	100 tons	.....	.....	.....	.....	Reduction.

Appeals Court Sustains Decision Against Luten Patents

Decision Scores Patentee for Methods in Promoting Concrete Bridge Patents Which Are Held Invalid

IN the United States Court of Appeals, Eighth Circuit, a decision was handed down on Jan. 15, 1920, sustaining the decision of the District Court of the United States for the District of Nebraska for its decision in the case of Daniel B. Luten vs. Wilson Reinforced Concrete Co., et al. This lower court decision held three of the Luten concrete bridge patents invalid and one other under suit not infringed. The upper court decision goes further and holds the fourth patent invalid. In addition, the decision, written by Judge Amidon, District Judge, and concurred in by Judge Hook, Circuit Judge, severely scores Mr. Luten for the methods used in promoting his patent. The decision is as follows:

This suit was brought by Daniel B. Luten against the Wilson Reinforced Concrete Co. and others, to restrain infringement of Letters Patent 853,202, 853,203, 818,386, 999,663. The case was heard upon elaborate proofs, and the bill dismissed on the ground that Patent 999,663 was not infringed, and that the others were void for want of invention (254 Fed. 107). The case was heard in this court at the same term as Luten vs. Young and Luten vs. Allen (opinion in which is concurrently filed). There is advantage in getting as many of the numerous patents issued to Mr. Luten as possible under examination at the same time. It would aid in determining the merits of each if the same court could see them all at a single view.

Insofar as we can discover, none of the Luten patents has ever been sustained in a contested case, and they have been frequently held to be invalid for want of patentability. Notwithstanding this experience these patents have been exploited by a skillful campaign of advertising in which it has been repeatedly asserted that no suit based on a Luten patent has ever been lost or dismissed. This work has been done through the agency of the National Bridge Co. of Indianapolis. The record in this case leaves no room for doubt that the entire scheme by which it has promoted these patents has been fraudulent. We shall call attention to a few of the more glaringly culpable of the representations, quoting in the main the exact language of the circulars.

1. "The National Bridge Company of Indianapolis, Ind., now owns seventeen Luten Patents on cost-saving devices in concrete bridges. Forty-seven other applications for Luten patents are still pending. Several of the above patents have been declared valid in the United States Circuit Courts with injunctions issued against infringers, and numerous other suits for infringement are being filed. No infringement suit based on a Luten patent has ever been lost or dismissed."

2. A skillfully printed advertisement headed, "Luten Patent Decrees," lists the patents, twenty-four in number, and states under each patent the court and title of the case in which a consent decree had been obtained, without disclosing that the decrees were by consent. By repeating the cases under the several patents involved, without calling attention to that fact, the impressiveness of the showing to a casual reader is greatly enhanced.

3. Another advertisement headed, "To Whom It May Concern," lists sixteen patents with date of issue and year of expiration. It states:

"The above sixteen patents contain two hundred ninety claims.

". . . If one of these claims be infringed, the owner of the patent may collect royalty and costs in a suit for an injunction. If it be shown that the infringement was knowingly made, punitive damages to the amount of three times the actual damages proved may be assessed by the court. . . .

"If a judgment cannot be collected from a municipality, county or town, as, for example, when a board refuses to settle for infringements by its predecessors in office, a judgment may be enforced against the individual officers who authorized the infringement and their private property sold on execution to satisfy the judgment.

"If two or more parties infringe in the same structure, as when a contractor builds for a municipality on designs furnished by an engineer, the owner of the patent may elect which of the three he shall prosecute, the engineer, or the municipality, or the contractor, and may sue any or all of them. . . .

"The validity of the patent does not depend on the state of the art at the time the patent was issued. It depends to some extent on the state of the art two years before the patent was applied for. Many of the above patents were under examination by the patent office for many years before they were issued. . . .

"If it be shown . . . that a single claim of a valid patent is being infringed, the court will issue an injunction forever restraining the continuance of the work and assessing costs and damages. An injunction to restrain future infringements may issue before or *after* the work is completed. . . .

"Such a suit is never tried before a jury. State Courts have no jurisdiction. Suit may be brought in any part of the United States without the employment of local attorneys. The principal items of expense in such cases are attorney fees, traveling expenses in taking depositions, printing the record which may amount to thousands of dollars in severely contested cases, and court costs."

The advertisement then calls attention to two specific cases in which the cost of the litigation amounted to from forty to fifty thousand dollars.

4. Another showing is a collection in separate documents of all the consent decrees.

5. Another advertisement sets forth that fifteen thousand designs for concrete bridges have been supplied under the Luten patents, and over six thousand of them have been actually erected.

The foregoing elements have been used in a brilliant campaign of promotion. The arts of the advertiser and the photographer have been brought to a perfection seldom equalled. All the above themes have been pressed with masterful skill in that form of argumentation which is peculiar to the patent lawyer and the patent expert—a union of science and logic. We call attention to only two of the most reprehensible features of this campaign of deception by the use of half truths. First, the use of consent decrees throughout the entire literature without disclosing that they are by consent, and not the result of litigation. Second, the threats of patent litigation. This has been practiced with a studied use of menacing arts that would have been blackmail on a vast scale if the [illegible] had only been criminal instead of civil prosecution. In law this is a saving distinction, but not in ethics.

We have examined the patent here directly involved, and the others contained in the record, and the numerous patents of the plaintiff which have been described in the cases to which we have referred. We are convinced that they are all void for want of patentable invention. Not one of them has ever been sustained in a contested case. They ought not to be. The use of steel to reinforce concrete was more than a quarter of a century old when Mr. Luten entered the field in 1902. The history of the art is given by this court in Luten vs. Washburn, 253 Fed. 950, and the Court of Appeals of the Sixth Circuit in Luten vs. Whittier, 251 Fed. 590. He has added nothing that is patentable to the art. All he has done is to make such modifications, either in the arrangement of the rods or their form, as in his judgment would best meet the stress of the particular structure. That is the work of the engineer. There is nothing generic about any of his patents. Judging by his drawings and specifications, and the multitude of his patents and applications for patents, what he has done is to prepare drawings and specifications for a particular bridge, then put these in the form required by the patent law, and present them with the necessary fees to the Patent Office as an application for patent. When one considers the number of patents granted,

and applications pending, he has met with an inexplicable success.

While Mr. Luten has made no invention, he has made a great discovery, namely, that not more than one city or county attorney, or attorney general in ten knows anything about patent law, or the proper interpretation of consent decrees in that field. It has resulted that cities, counties and states have been easy victims for the peculiar arts of the National Bridge Co., for they were without trustworthy legal advice. With the above elements to play upon, it has been easy to convince public authorities that the way of safety was the way of wisdom, and that this consisted in employing Mr. Luten as an engineer, or paying him ten per cent royalty for the use of his patented device.

Mr. Luten is entitled to all the advantages which belong to him as an engineer. That is the full measure of his right. He is entitled to nothing under the patent law. At a time when many of the states are appropriating tens of millions of dollars for good roads, and each of these appropriations is being duplicated by the federal government, and reinforced concrete bridges are indispensable factors in these great enterprises, a continuation of the Bridge Company's practices under these void patents would be a grave public wrong.

The decree is modified insofar as it holds patent No. 999,663 not infringed, so as to hold it also void for want of patentable invention, and as so modified the decree is affirmed.

This is one of the cases in which the State of Nebraska assumed a part of the defense of the suit. Mr. Luten was represented by Russell T. MacFall (F. H. Drury and F. M. Hall were with him on the brief) and the appellees by Wallace R. Lane (C. A. Davis and W. F. Moran were with him on the brief).

Women in British Industry

The Women's Industrial League, the main object of which is to secure equal opportunities for employment as between men and women in all occupations, sent out recently a circular letter to some 5,000 firms in Great Britain asking certain questions relative to the employment of women. Replies from 1,422 firms engaged in engineering and allied work were received, and a summary of these just published by the league shows that the firms in question employed 79,700 women at the end of May, 1919, as compared with 43,200 before the war and 245,300 during the war. The number of war workers who have been retained is rather striking, as the returns do not include women engaged as clerks, ...rs, typists, canteen workers, and cleaners. In "general engineering" the returns of 587 firms show that 28,200 women were employed six months ago, as compared with 14,100 before the war and 134,600 during the war. In "foundry work," a trade of some interest at the present time, 279 firms replied, the number of women in the three categories being respectively 3,200, 950, and 19,400. Of the 764 firms who had employed women for the first time during the war, 228, or 30 per cent, propose to retain them and make no comment on the present labor situation. A further 97 firms would retain them if it were not for the opposition of the trade unions. The reasons given by the employers for not favoring employment of women are various, but will be generally familiar to engineers—the Home Office restrictions on night work, the unsuitable nature of the heavier work in shipyards, foundries, etc., the government regulation compelling girls of 18 years of age to be paid the full rate of wages, the increased supervision necessary when women are employed, and so on. [From the Engineering Supplement of the *Times*, London.]

Hoover—On Engineer's Interest in Public Questions

Discusses, Before Mining Engineers, Governmental Problems, the Railroads, Shipping and Industrial Relations

DECLARING that in their advocacy of various public measures now before Congress "engineers want nothing for themselves," Herbert C. Hoover, in his inaugural address as president of the American Institute of Mining and Metallurgical Engineers in New York, Feb. 17, reviewed broadly some public questions in which engineers have been taking a special interest. He devoted much time to the railroad and shipping problems, pointing out the inevitable inefficiency of Government operation and the very great complexity of the shipping situation. He endorsed the project for the establishment of a Department of Public Works and approved the engineers' commendation of a national budget system.

The following extracts from his address deal chiefly with the general aspects of our industrial situation and with the railroad and shipping problems:

Post-War Situation

We have in this country probably one hundred thousand professional engineers. The events of the past few years have greatly stirred their interest in national problems. This has taken practical form in the maintenance of joint committees for discussion of these problems and support to a free advisory bureau in Washington. The engineers want nothing for themselves from Congress. They want efficiency in government, and you contribute to the maintenance of this bureau out of sheer idealism. This organization for consideration of national problems has had many subjects before it, and I propose to touch on some of them this evening.

Even more than ever before is there necessity for your continued interest in this vast complex of problems that must be met by our Government. We are faced with a new orientation of our country to world problems. We face a Europe still at war; still amid social revolutions; some of its peoples still slacking on production; millions starving; and therefore the safety of its civilization is still hanging by a slender thread. Every wind that blows carries to our shores an infection of social disease from this great ferment; every convulsion there has an economic reaction upon our own people. If we needed further proof of the interdependence of the world, we have it today in the practical blockade of our export market. The world is asking us to ratify long-delayed peace in the hope that such confidence will be restored as will enable her to reconstruct her economic life. We are today contemplating maintenance of an enlarged Army and Navy in preparedness for further upheavals in the world and failing to even provide some insurance against war by a league to promote peace.

Out of the strain of war weaknesses have become even more evident in our administrative organization, in our legislative machinery. Our Federal Government is still overcentralized, for we have upon the hands of our Government enormous industrial activities which have yet to be demobilized. We are swamped with debt and burdened with taxation. Credit is woefully inflated; speculation and waste are rampant. Our own productivity is decreasing. Our industrial population is crying for remedies to the increasing cost of living and aspiring to better conditions of life and labor. But, beyond all this, great hopes and aspirations are abroad; great moral and social forces have been stimulated by the war and will not be quieted by the ratification of peace. These are but some part of the problems with which we must deal. I have no fear that our people will not find solutions; but progress is sometimes like the old-fashioned rail fence—some rails are, perhaps mis-shapen,

and all look to point the wrong way; but in the end, the fence progresses.

The war nationalization of railways and shipping are our two greatest problems in Government control awaiting demobilization. There are many fundamental objections to continuation of these experiments in socialism necessitated by the war. They lie chiefly in their destruction of initiative in our people and the dangers of political domination that can grow from governmental operation. Beyond this, the engineers will hold that the successful conduct of great industries is to a transcendent degree dependent upon the personal abilities and character of their employees and staff.

No scheme of political appointment has ever yet been devised that will replace competition in its selection of ability and character. Both shipping and railways have today the advantage of many skilled persons, sifted out in the hard school of competition, and even then the Government operation of these enterprises is not proving satisfactory. Therefore, the ultimate inefficiency that would arise from the deadening paralysis of bureaucracy has not yet had full opportunity for development. Already, we can show that no government, under pressure of ever-present political or sectional interests, can properly conduct the risks of extension and improvement, or can be free from local pressure to conduct unwarranted service in industrial enterprise. On the other hand, our people have long since recognized that we cannot turn monopoly over to unrestrained operation for profit nor that the human rights of employees can ever be dominated by dividends.

Our business is handicapped on every side by the failure of our transportation facilities to grow with the country. It is useless to talk about increased production to meet an increased standard of living in an increasing population without a greatly increased transport equipment. Moreover, there are very great social problems underlying our transport system. Today their contraction is forcing a congestion of our population around the great cities, with all that these overswollen settlements import. Even such great disturbances as the coal strike have a minor root in our inadequate transportation facilities and their responsibility for intermittent operation of the mines.

We are all hoping that Congress will find a solution to this problem that will be an advanced step toward the combined stimulation of the initiative of the owners, the efficiency of operation, the enlistment of the good will of the employees, and the protection of the public. The problem is easy to state. Its solution is almost overwhelming in complexity. It must develop with experience, step by step—toward a real working partnership of its three elements.

The return of the railways to the owners places predominant private operation upon its final trial. If instant energy, courage, and large vision in the owners should prove lacking in meeting the immediate situation we will be faced with a reaction that will drive the country to some other form of control. Energetic enlargement of equipment, better service, co-operation with employees, and the least possible advance in rates, together with freedom from political interest, will be the scales upon which the public will weigh these results.

Shipping Problem

Important phases of our shipping problem that have come before you should receive wider discussion by the country. As the result of war pressure, we will spend over $2,800,000,000 in the completion of a fleet of nineteen hundred ships, of a total of 11,000,000 tons—nearly one-quarter of the world's cargo shipping. We are proud of this great expansion of our marine, and we wish to retain it under the American flag. Our shipping problem has one large point of departure from the railway problem, for there is no element of natural monopoly. Anyone with a water-tight vehicle can enter upon the seas today, and our Government is now engaged upon the conduct of a nationalized industry in competition with our own people and all the world besides. While in the railways Government inefficiency could be passed on to the consumer, on the seas we will sooner or later find it translated to the national Treasury.

Until the present time, there has been a shortage in the world's shipping, but this is being rapidly overtaken, and we shall soon be met with fierce competition of private industry. If the Government continues in the shipping business, we shall be disappointed from the point of view of profits; for we shall be faced with the ability of private enterprise to make profits from the margins of higher cost of Government operation alone. Aside from those losses inherent in bureaucracy and political pressure, there are others special to this case. The largest successfully managed cargo fleet in the world comprises about one hundred and twenty ships, and yet we are attempting to manage nineteen hundred ships at the hands of a Government bureau. In normal times the question of profit or loss in a ship is measured by a few hundred tons of coal wasted, by a little extravagance in repairs, or by the four or five days on a round trip. Beyond this, private shipping has a free hand to set up such give-and-take relationships with merchants all over the world as will provide sufficient cargo for all legs of a voyage, and these arrangements of co-operation cannot be created by Government employees without charge or danger of favoritism. Government officials are unable to enter upon the detailed higgling in fixing rates required by every cargo and charter. Therefore, they must take refuge in rigid regulations and in fixed rates. In result, their competitors underbid by the smallest margins necessary to get the cargoes. The effect of our large fleet in the world's markets is thus to hold up rates, for so long as this great fleet, on one hand, holds a fixed rate others will only barely underbid. If we hold up rates an increasing number of our ships will be idle as the private fleet grows. On the other hand, if we reduce rates we shall be underbid until the Government margin of larger operation cost causes us to lose money.

We shall yet be faced with the question of demobilizing a considerable part of this fleet into private hands, or frankly acknowledging that we operate it for other reasons than interest on our investment. In this whole problem there are the most difficult considerations requiring the best business thought in the country. In the first instance, our national progress requires that we retain a large fleet under our flag to protect our national commercial expansion overseas. Secondly, we may find it desirable to hold a considerable Government fleet to build up trade routes in expansion of our trade, even at some loss in operation. Thirdly, in order to create this fleet, we have built up an enormous shipbuilding industry. Fifty per cent of the capacity of our shipyards will more than provide any necessary construction for American account. Therefore there is a need of obtaining foreign orders, or the reduction of capacity, or both. I believe, with most engineers, that, with our skill in repetition manufacture, we can compete with any shipbuilders in the world and maintain our American wage standards; but this repetition manufacture implies a constant flow of orders. It would seem highly desirable, in order to maintain the most efficient yards until they can establish themselves firmly in the world's industrial fabric, that the Government should continue to let some ship construction contracts to the lowest bidders. These contracts to supplement private building in such a way as to maintain the continuous operation of the most economical yards and the steady employment of our large number of skilled workers engaged therein.

When we consider giving orders for new ships, we must at the same time consider the sale of ships, as we cannot go on increasing this fleet. When we consider sale, we are confronted with the fact that our present ships were built under expensive conditions of war, costing from three to four times per ton the pre-war amount, and that already any merchant, subject to the long time of delivery, can build a ship for seventy-five per cent of their cost. It would at least seem good national policy to sell ships today for the price we can contract for delivery a year or two hence, thus making the Government a reservoir for continuous construction. We could thus stabilize building industry to some degree and also bring the American-owned fleet into better balance, if, as the Government sold three or four emergency-constructed cargo vessels, it gave an

order for one ship of a better and faster type. This would make reduction in our shipbuilding steadier and would give the country the type of ships we need. . . .

I am daily impressed with the fact that there is but one way out [of our industrial-relations difficulties], and that is to again re-establish, through organized representation, that personal co-operation between employer and employee in production that was a binding force when our industries were smaller of unit and of less specialization. Through this, the sense of craftsmanship and the interest in production can be re-created and the proper establishment of conditions of labor and its participation in a more skilled administration can be worked out. The attitude of refusal to participate in collective bargaining with representatives of the employees' own choosing is the negation of this bridge to better relationship. On the other hand, a complete sense of obligation to bargains entered upon is fundamental to the process itself.

The interests of employee and employer are not necessarily antagonistic; they have a great common ground of mutuality, and if we could secure emphasis upon these common interests we would greatly mitigate conflict. Our Government can stimulate these forces, but the new relationship of employer and employee must be a matter of deliberate organization within industry itself. I am convinced that the vast majority of American labor fundamentally wishes to co-operate in production and that basis of good will can be organized and the vitality of production re-created.

Many of the questions of this industrial relationship involve large engineering problems, as an instance of which I know of no better example than the issue you plan for discussion tomorrow in connection with the soft-coal industry. Broadly, here is an industry functioning badly from an engineering and consequently from an economic and human standpoint. Owing to the intermittency of production, seasonal and local, this industry has been equipped to a peak load of 25 or 30 per cent over the average load. It has been provided with a 25 or 30 per cent larger labor complement than it would require if continuous operation could be brought about. I hope your discussion will throw some light on the possibilities of remedy. There lies in this intermittency not only a long train of human misery through intermittent employment, but the economic loss to the community of over a hundred thousand workers who could be applied to other production, and the cost of coal could be decreased to the consumer. This intermittency lies at the root of the last strike in the attempt of the employees to secure an equal division among themselves of this partial employment at a wage that could meet their view of a living return on full employment.

Our Own Social Philosophy

These are but few of the problems that confront us. But in the formulating of measures of solution, we need a constant adherence to national ideals and our own social philosophy.

In the discussion of these ideals and this social philosophy, we hear much of radicalism and of reaction. They are, in fact, not an academic state of mind but realize into real groups and real forces influencing the solution of economic problems in this community. In their present-day practical aspects, they represent on one hand roughly various degrees of exponents of socialism, who would directly or indirectly undermine the principle of private property and personal initiative, and, on the other hand, those exponents who in various degrees desire to dominate the community for profit and privilege. They both represent attempts to introduce or preserve class privilege, either a moneyed or a bureaucratic aristocracy. We have, however, in American democracy an ideal and a social philosophy that sympathizes neither with radicalism nor reaction as they are manifested today.

For generations the American people have been steadily developing a social philosophy as part of their own democracy—and in these ideals it differs from all other democracies. This philosophy has stood this period of test in the fire of common sense; it is, in substance, that there should be an equality of opportunity—an equal chance—to every citizen. This view that every individual should, within his lifetime, not be handicapped in securing that particular niche in the community to which his abilities and character entitle him, is itself the negation of class. Human beings are not equal in these qualities. But a society that is based upon a constant flux of individuals in the community, upon the basis of ability and character, is a moving, virile mass; it is not a stratification of classes. Its inspiration is individual initiative. Its stimulus is competition. Its safeguard is education. Its greatest mentor is free speech and voluntary organization for public good. Its expression in legislation is the common sense and common will of the majority. It is the essence of this democracy that progress of the mass must arise from progress of the individual. It does not permit the presence in the community of those who would not give full meed of service.

Its conception of the State is one that, representative of all the citizens, will in the region of economic activities apply itself mainly to the stimulation of knowledge, the undertaking only of works beyond the initiative of the individual or group, the prevention of economic domination of the few over the many, and the least entrance into commerce that Government functions necessitate.

If we cling to our national ideals it will mean the final isolation and the political abandonment of the minor groups who hope for domination of the Government, either by "interests" or by radical social theories through the control of our political machinery. I sometimes feel that lawful radicalism in politics is less dangerous than reaction, for radicalism is blatant and displays itself in the open. Unlawful radicalism can be handled by the police Reaction too often fools the people through subtle channels of obstruction and progressive platitudes. There is little danger of radicalism ever controlling a country with so large a farmer population, except in one contingency. That contingency is from a reflex of continued attempt to control this country by the "interests" and other forms of our domestic reactionaries.

The mighty upheaval following the World War has created turmoil and confusion in our own country no less than in all other lands. If America is to contribute to the advance of civilization, it must first solve its own problems, must first secure and maintain its own strength. The kind of problems that present themselves are more predominantly economic—national as well as international—than at any period in our history. They require quantitative and prospective thinking and a sense of organization. These are the sort of problems that your profession deals with as its daily toil. You have an obligation to continue the fine service you have initiated and to give it your united skill.

New York State Health Laboratory Building

To provide enlarged quarters for the Division of Laboratories and Research of the New York State Department of Health there has been built at Albany a fireproof brick and reinforced-concrete building 50 x 150 ft. in outside floor plan, with a basement and three stories. The first floor is devoted to administration offices, serum diagnostic laboratories, the preparation of bacterial media, specimen recording, preparation of outfits, and the general handling of supplies. On the second floor is the library, the director's office and private laboratory, and laboratories for bacterial diagnostic and research. The third floor is devoted to chemical laboratories, rooms for the preparation of serum, antitoxin, and bacterial vaccine, besides various special rooms. Ventilation is provided by means of exhaust fans driven by motors located at the top of the building. The laboratory as a whole, which contains a considerable number and variety of conveniences, is described in more detail than is here given in *Health News* for December, the monthly bulletin of the New York State Department of Health.

LOOKING DOWN ON THE NEARLY COMPLETED KERKHOFF DAM IN THE SAN JOAQUIN VALLEY, CAL.

Concrete Arch Dam Built From Superposed Trestle

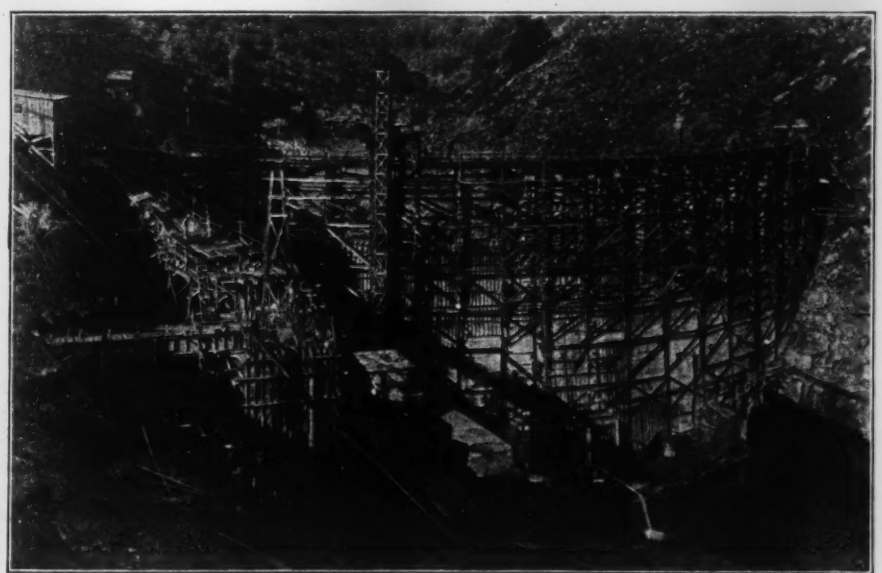
Framework Erected Complete Before Starting Dam—Concrete Elevated to Cars on Top and Dropped Through Chutes

POWER demands in the San Joaquin Valley in California have led to the construction by the San Joaquin Light and Power Co. of the Kerkhoff hydroelectric development about forty miles east of Fresno. The reservoir is created in a narrow, inaccessible canyon by the construction of a simple, constant-angle dam of concrete, with a radius of 205 ft. on the upstream face and a total height of 108 ft. The rapid construction of the dam, made necessary by the growing power shortage, was facilitated by the use of a wooden trestle, which served both as a backing for the concrete forms and as the main part of the concrete delivery system.

As soon as the foundation concrete was placed inside the cofferdam which shut off the river flow, the trestle shown in the accompanying views was erected immediately over the dam site and following in plan the curve of the arch, so that the trestle completely inclosed the prospective dam section. The concrete-mixing plant was located on the side hill just upstream of the dam and at such a height so that its discharge would be by gravity to the lower part of the dam section and its feed hopper be just below a track leading from the stone crusher some distance downstream of the dam. At the foot of the mixer was erected a concrete hoist tower dumping into hoppers on various levels of the trestle, on which were tracks on which run hopper cars hauled by gasoline motors. Between the rails of the tracks were openings leading into wood box chutes by which the concrete was fed to the dam.

In concreting the upper part of the dam crushed stone aggregate was brought to the mixing plant by gravity on a railway laid from the quarry downstream and the cement slid down the adjoining hill, also by gravity. The concreting-car track was moved from one level to a higher one as the dam rose in construction, but the maximum depth of drop through the chutes was kept at about 50 ft. It is stated that there was no chance of separation of the elements of the mix and the impact had a decided tendency to consolidate the concrete in the forms.

It was also decided in building the trestle that time



UPSTREAM OF THE KERKHOFF DAM—CONCRETE-MIXING PLANT AND CONCRETE MATERIAL BROUGHT IN ON TRESTLE AT LEFT

and expense would be saved if the batter posts of the trestle could be used as guides from which to locate the concrete forms, which have somewhat complicated location on account of the curve of the dam. Accordingly a batter was selected for each individual trestle bent which would bring the posts no nearer than 12 in. from the finished concrete at any point. The bents were located 15 ft. apart and the exact distance of each batter post from the face of the dam was calculated for every 10 ft. of its height. These called for bents with a maximum footing spread of 30 ft. and a width of 10 ft. at the top.

The trestle was built to full height at the outset as a single operation, thus affording a better opportunity to see that each batter post was secured in a carefully located position. The levels at which concrete was poured from the trestle, four in all, were floored over as they were needed and the flooring was removed when operations were moved to a higher level. As the level of concrete and forms reached successive braces these were removed. Occasionally sinker bolts were put in the concrete to provide means of steadying the trestle as the bracing system was taken away.

TOP OF CONCRETING TRESTLE ON KERKHOFF DAM

Working according to this plan it was unnecessary to take the transit onto the trestle itself. The instrument was set up only on the finished concrete where it could check the positions of the batter posts for, say, 25 ft. above. The checking did not need to be carried higher than the forms would be built before the next checking.

All the batter posts were marked conspicuously with numbers which corresponded to numbers on the plans. It was the duty of the general foreman of carpenters to take from the blueprints, under the supervision of the resident engineer, the distance of batter post to forms as calculated for each level and to see what these measurements were to be.

As will be noted from the views herewith, the dam site is in extremely rugged country. It was necessary to bring in all supplies down a 3,000-ft. incline, parts of which were as steep as 92.5 per cent. The canyon was also too narrow and steep to afford space on which materials could be stored, so platforms or warehouses were built as needed along the lower portion of the inclined track. Bunkhouses and camp structures generally had to be supported on stilts on the downhill side, and the men could move about the camp safely only on the trail graded for the purpose.

In spite of the topographical difficulties, work was carried out very rapidly. Authority to proceed was given on April 22, 1919. Fifteen days later diamond drills had been lowered down the steep hillside on skids and were at work on the foundation. On May 30 a 5-mi. wagon road had been built into the site and the inclined track leading down into the site was in operation. Meanwhile materials and equipment for a camp of 100 men had been brought in over a trail and lowered down the incline site on skids. Thus the camp was in full operation before there was time to build the incline. The first concrete in the river section of the dam was poured on Sept. 13 and the total of 25,000 cu.yd. was completed by Dec. 15, 1919.

The work is under the direction of R. C. Starr, construction engineer for the San Joaquin Light and Power Co. W. A. Whitmire is general superintendent and E. H. Warner, resident engineer.

Railroad Work in England

The Engineering Supplement of the London *Times*, in its annual review number, January, 1920, prints the following in regard to railroad activities in England:

"The new Ministry is giving consideration to the extension of co-ordinated working, to questions of standardization of equipment, additions to electrically operated railways, and the concentration of manufacturing resources. Few new lines are projected, the main work immediately ahead being that of bringing the existing tracks up to the old standard and of proceeding with widening schemes to facilitate the movement of traffic. The great increase in the present-day costs of carrying out railway works as compared with the prices at which contracts could have been placed in former years, has made it necessary to review all large works which were under consideration in 1914, with the object of determining whether they ought to be proceeded with under existing conditions. Nearly all railway companies have, however, a certain number of widening schemes in hand. During the past year the North-Eastern Railway carried out a good deal of work of this kind on the main lines between Newcastle and Tweedmouth and between Newcastle and Carlisle, thus providing improved running facilities for the exceptionally heavy traffic which passes over these sections. The proposal to electrify a large mileage of main line is referred to elsewhere. The Great Northern Railway has done a good deal of similar work and has brought into partial use the Enfield-Stevenage line, which provides an alternative route on the southern part of that system. The Midland, Great Western, South-Western, and London and North-Western Railways are giving attention to the same subject, and the last-named is pushing forward the completion of the electrification of the Willesden-Euston section of its suburban line."

How the Province of Quebec Controls its Water Power

Through Quebec Streams Commission Provincial Government Rivers Are Regulated So As to Provide Uniform Flow and Rights to Power Are Leased to Private Interests to Financial Benefit of the Province

By Olivier Lefebvre
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Abstract of a paper read at the general professional meeting of the Engineering Institute of Canada, Montreal, Jan. 25, 1920.

UNDER the laws of Quebec navigable and floatable rivers and streams and their banks are considered as being dependencies of the crown domain. It follows that there are two classes of rivers: those that are navigable and floatable, and those that are not navigable and not floatable. The bed of the rivers in the first class is the property of the crown and, consequently, the water powers thereon located are public domain. The bed of the rivers of the second class is the property of the owners of their banks as far as the center of the stream, provided the ownership of the bank was acquired before June 1, 1884. Since the latter date, the sales and free grants of crown lands are and have been subjected to the reserve of a strip three chains wide in favor of the crown. Therefore the river bed is owned by the crown, except in that part of the province where shore lots have been sold before 1884.

Power sites in this province have been disposed of in various ways. From 1867 to 1897, no water powers have been sold as such, but mill sites were sold outright for a nominal sum. At that period, the transformation of water power into electricity was in its infancy, and no great importance was attached to the falls and rapids on our rivers.

From 1897 to 1907, when notable progress was made in the design of generators and the transmission of current, the sale of water powers was largely increased. They were sold outright for what was then considered high prices, and somewhat more severe conditions were imposed, such as the obligation of spending a large amount of capital within a few years. The Shawinigan Falls were sold under these conditions.

This policy was later the subject for much criticism. It was argued that such valuable resources as those represented by water powers should be kept for the people and not vested in private interests. However, in the opinion of the writer this policy was completely justified. The development of water power was to a certain extent an experiment, the waterwheel was far from having the efficiency which it has today, and the capitalists willing to invest money in such development deserved full encouragement. It is doubtful if they could have financed their power schemes had they not been assured that the improvements carried out would be on a property for which they had a clear title.

One danger of this policy was that as the value of the water powers increased, certain sites might be acquired without any development being proposed, but for the sake of holding the property for speculation purposes. This could be remedied and was, to a large extent, by stipulating that a certain amount had to be spent for development within a certain time.

From 1907 to the middle of 1910, some water powers were sold and others were leased. A sale took place in the case of small powers only. From the middle of 1910 to date, water powers have been leased for periods of seventy-five and ninety-nine years—in one case only the lease extending over a period of sixty-two years.

However, in the case of small powers not exceeding 200 hp., the government sells for a definite sum the bed of the river with the shore rights, and the water powers included. Prior to Law 7 George V, chapter 22, article 1636, it was not possible for the government to sell public land which was included in a territory licensed for timber cutting. Now this power is vested in the Lieutenant-Governor in Council when such land is necessary to the development of the leased water power. Since March 16, 1916, all concessions of river beds may be made only with the authorization of the Lieutenant-Governor in Council.

The administration of the water powers of the province is under the Department of Lands and Forests, more particularly through its hydraulic service branch.

Quebec's Water-Power Policy

The policy which prevails is the following:

1. Water powers are leased for a period of twenty-five to ninety-nine years, according to the importance of the power and the capital required for development.
2. For the land granted a payment is required of a fixed annual rental covering the term of the lease.
3. There is required a supplementary annual rental which may vary from 10 to 35c. per horsepower development, according to the facilities or difficulties of development. This supplementary rental may be revised every twenty-one years.
4. Two years is allowed within which to start development, and two more years to begin the production of power.
5. A deposit guarantee must be made.
6. The lessee must submit plans of the proposed works and report to the Department of Lands and Forests as to the amount of power developed in the plant.

In the case of rivers which are navigable and floatable, the lessee must submit his plans to the federal government which has to protect the interests of navigation.

All water powers which, at mean low water have a capacity of 200 hp. and over have been declared of public interest, and the owner of such water powers may proceed to the expropriation of adjacent lands required for the proper development of its property, but this expropriation cannot be exercised against an industry previously established, or waterworks supplying the whole or part of a municipality.

A law was passed in 1918 which stipulates that the plans and specifications for works proposed in streams of the province must be submitted to the Lieutenant-Governor in Council for approval. Before 1918 it was not possible to build dams for storage purposes unless authorized to this effect by a bill of the Legislature, but in 1918 a law was passed by which such works may

now be carried out, provided the plans and specifications have been submitted to the Lieutenant-Governor in Council and approved.

Such is today the water-power policy of the province, and it is claimed that it affords safety for capital invested. It assures the public of a share in the value of these natural resources, and it prevents any speculation in that development being imposed within a definite period under penalty of the lease being cancelled and the deposit confiscated.

Amount of Power Developed

The amount of power there is available in Quebec has been estimated by Arthur Amos, Chief of the Hydraulic Service, as being five million horsepower, not including any territory above the fiftieth degree of latitude. As to the amount of power in the latter territory, no accurate estimate has been made.

A census of water powers developed in the Province of Quebec in 1918 was made by the Hydraulic Service. It was found that the amount of power installed was 832,274 hp. And this total does not include any station generating less than 1,000 hp. It is estimated that, should the smaller developments be included, the amount of hydro-power installed in the province must be 875,000 hp. Statistics prepared by the Dominion Bureau of Statistics, in collaboration with the Dominion Water Power Branch and the Hydraulic Service of Quebec, published recently, state that on the first of January, 1918, the primary power generated by water in this province was 575,551 hp., or 257 hp. per thousand of population. The statistics compiled by the province mention the capacity installed, while the dominion statistics mention primary power. The capital invested in the central electric stations in Quebec was at that time $130,000,000. The total revenue from the sale of power at these stations was $14,350,000, and new installations contemplated were estimated at about 200,000 hp.

Work of the Quebec Streams Commission

The Quebec Streams Commission has done a large amount of work which has made very important power sites considerably more valuable, both in the case of developed and undeveloped water powers. This Commission was appointed in the latter part of the year 1911. Among the duties it is called upon to perform, there are the following:

1. To devise just and practical rules respecting the flow, the drawing off, the disposal, the distribution, the storage and generally respecting the preservation and management of running waters in the Province of Quebec.

2. To consider whether it is expedient to have the rivers of the province classified as navigable and floatable rivers, and rivers which are not navigable nor floatable, classified by an administrative commission or otherwise, according to uniform rules, and to submit such rules, if it be advisable.

The Commission is formed of three members; one chairman and two commissioners, at this time both civil engineers.

The first work which the Quebec Streams Commission was called upon to make was an investigation of the characteristics of the rivers of this province and, in 1913, it submitted a report recommending that the said rivers be classed as being public or private property—according to the area of their watershed. It recommended that the expressions "navigable" and "floatable" be eliminated, and that all rivers having a drainage area of 300 sq.mi. or over should be public property, and that all rivers with an area less than 300 sq.mi. should be private property.

The most important work which the Commission has performed to date is the regulation of the flow of the St. Maurice River and that of the St. François River. In the case of the former river, a complete control of the water supplied by a drainage basin of 3,650 sq.mi. has been established near the head waters of the river.

St. Maurice River-Flow Regulation

The St. Maurice River flows into the St. Lawrence at Three Rivers, about half-way between Montreal and Quebec. Its drainage area is 17,000 sq.mi. and the river is about 365 mi. long. The difference in level between its head waters and its mouth is approximately 1,300 ft. This grade is distributed in a large number of rapids and some high falls.

Of these powers, full developments have been carried out at Shawinigan under a head of 150 ft., and at Grand Mère under a head of 75 ft. At the latter point, the natural fall is 40 ft., but by building a high dam the water is backed up about 25 mi. and small falls and rapids are flooded.

Under natural conditions, the minimum flow of the St. Maurice River at Shawinigan was 6,000 cu.ft. per sec. It reached the absolute minimum of 5,200 sec.-ft., but for a few days only during the period 1900-1912. Daily records of the flow of this river at Shawinigan have been kept by the Shawinigan Water and Power Co. from 1900 to date. As the demand for power was increasing largely the need of increasing the minimum flow was felt, and the St. Maurice Hydraulic Company, in 1910, built three small storage dams on the Manouane River—a tributary to the St. Maurice River into which it flows near the Indian post at Weymontachingue, about 188 mi. above Shawinigan. These small reservoirs paved the way of the regulation on a larger scale as carried out by the Commission, for they had proved that the water which was let out from these small dams in winter reached Shawinigan with comparatively little loss. This possibility had been doubted somewhat.

In 1912, the St. Maurice Hydraulic Co., Ltd., applied to the legislature for authorization to carry out a storage scheme in the upper St. Maurice. The government did not deem it advisable to grant the power demanded, but it decided the Quebec Streams Commission was the proper party to look into the question and carry out the scheme if it was thought desirable. After a thorough examination of the whole question, it was decided to build a dam at the foot of a large series of lakes at a point two miles above the falls called "La Loutre." The construction of the dam was started in 1915 and it was completed in the month of December, 1917. The cost of the total scheme, including the acquisition by the Commission of the three storage dams on the Manouane River, amounts to $2,500,000. (See *Engineering News*, May 11, 1916, p. 876.)

As a result of the control of the waters by this dam, which is now called "the Gouin Dam," the minimum flow of the river is kept at 12,000 sec.-ft. at Shawinigan. Thus the primary power capacity of the plants at Shawinigan and Grand Mère has been doubled.

For the benefits derived from the storage, the power

companies are paying to the government an annual sum amounting now to $191,000. This annual revenue will be largely increased when other water powers are developed.

The capacity of the reservoir created by the Gouin Dam is estimated to be one hundred and sixty billion cubic feet, and it is the largest power reservoir in the world—having about twice the capacity of the Assuan reservoir in Egypt. It is, however, exceeded by the Gatun reservoir built in connection with the Panama Canal—the capacity of which is one hundred and eighty-three billion feet—but it is only fair to say that part only of this water can be used for supplying part of the Panama Canal.

The area of the lakes and the rivers affected by the Gouin Dam is 209 sq.mi., and with the reservoir full the area of the lake will exceed 300 sq.mi. The water is backed up a distance of 135 mi. above the dam.

The amount of power due to the storage has been calculated by using the flow curve of the lowest year during the period of 1900-1912—that is, the year 1906—and the figures arrived at were 32,000 hp.-years in the case of Shawinigan, and 16,000 hp.-years in the case of Grand Mère. It is estimated that the low water power possibility of the St. Maurice River has been increased by about 400,000 hp.

The control of the head waters of the St. Maurice River is also beneficial to the lumbering trade in this valley. The flood waters in the spring are not so high and the minimum flow is very much increased. Therefore, the driving of logs down the river may be carried out under better conditions. Water may be supplied for the log drive at a time when it is not required by the power companies and when it is needed to destroy log jams which are formed in certain rapids. For example, this year (1919), early in July, about one million and a half logs were jammed and aground in the Rapid Blanc, about 35 mi. upstream from La Tuque. The Commission was asked to help the association out of this difficulty by giving a shot of water. The Gouin Dam was opened to discharge 13,600 sec.-ft. during twelve days, raising the water to nearly flood conditions. All of the jammed timber was brought out of the rapid and floated down to La Tuque in about two weeks.

River St. Francois Regulation

The next storage scheme which the Commission was called upon to study was the partial regulation of the discharge of the St. François River, by a control of water supplied to Lake St. François and to Lake Aylmer, both near the head of the river.

Lake St. François is located six miles east from the town of Disraeli and about ten miles southwest from the town of Thetford Mines. River St. François has a drainage area of 4,100 sq.mi. and drains the largest part of the Eastern Townships. It flows into the St. Lawrence at the head of Lake St. Peter and runs through the towns of Disraeli, East Angus, Sherbrooke, Windsor Mills, Richmond and Drummondville. The distance between Lake St. François and Lake St. Pierre is about 120 mi., and the slope is practically 900 ft. This slope is distributed through numerous falls and rapids, making the river very desirable for power development.

By the construction of a dam at the outlet of Lake St. François, a complete control of the water running from a basin of 472 sq.mi. has been secured, and this water is being evenly distributed throughout the year at the rate of 600 cu.ft. per sec. The minimum flow from this lake, under natural conditions, has been measured as 100 sec.-ft. The minimum flow from this source has therefore been increased by 500 sec.-feet.

Lake Aylmer is located immediately below the town of Disraeli at an altitude of practically 100 ft. below that of Lake St. François. Its drainage area is 135 sq.mi., and its run-off is controlled by a dam at the outlet of the lake near the village of St. Gérard. It has been calculated that this lake will supply 150 sec.-ft. above its natural minimum flow.

The dam at Lake St. François can raise the water 27 ft. above natural low water, and the dam at St. Gérard can raise the water 112 ft. above natural low water. The storage capacity of the reservoir created by Lake St. François dam is 438 sq.mi., or 12.2 billion cu.ft. The reservoir is filled up in the spring.

The cost of the storage scheme on River St. François amount to $700,000. Of this capital cost, the power owners who reap benefits from the storage have been called upon to pay a yearly rental which covers the interest charges, the sinking fund within a period of thirty years, the cost of maintenance and repairs and a reasonable profit. The amount necessary to cover the above mentioned items is $59,000. The benefits to be derived by each company using the storage water could not be ascertained as no records of the flow of the river were available, and any figures as to additional power due to the storage could only be approximate. In the case of the St. Maurice River, it was different; our calculations were made from complete data. But in this case, to avoid any discussion or litigation as to the benefits derived, it was decided to divide the charges according to the head under which the water was used multiplied by the increase in the minimum discharge. This is called the "second-foot-head method." It is used by the Wisconsin Valley Improvement Co. to distribute the storage charges between the various power companies on the Wisconsin River. For example: the storage reservoir of Lake St. François supplies 500 sec.-ft. above the natural minimum flow. The water is used by the St. François Hydraulic Co. under a head of 40 ft. The charge of this company would be calculated as being $500 \times 40 = 20{,}000$ sec.-ft.-head. The companies which have their power plants located below Lake Aylmer receive an additional 150 sec.-ft. and, in the case of the Brompton Pulp and Paper Co., Ltd., which uses that water over a head of 85 ft., the proportion would be $650 \times 85 = 55{,}250$ sec.-ft.-head. The rate was therefore fixed at 50c. per sec.-ft.-head. Some of the plant owners have signed contracts and others have accepted the tariff just mentioned.

Other Activities of the Commission

A smaller storage scheme has also been carried out in the watershed of the River St. Anne de Beaupré, to increase the minimum flow at St. Ferréol, Seven Falls, where the Laurentian Power Co. operates a plant under a head of 410 ft. The minimum natural flow of the river at that point was 165 sec.-ft., and it is hoped to raise that minimum to 200 and over.

This storage is provided by a dam at the outlet of Lake Brulé and gives a control of the run-off from a watershed of 12 sq.mi. only. The Commission is contemplating additional storage on this river.

The other activities of the Quebec Streams Commission have been a complete study of the valley of the

Chaudière River, in the Beauce district, where disastrous floods occur occasionally. On July 31, 1917, after very heavy rains, the water rose 32 ft. in less than twenty-four hours. The Commission has been called upon to make a full report on the possible prevention of such disasters, and this report is now being prepared.

The Commission has also made a complete study of the possibilities of Lake St. John as a storage reservoir. It was found that by a suitable control at the outlet of this lake, it was possible to keep the minimum flow of the Saguenay River at 22,000 sec.-ft. without causing any damage to lands, wharves, etc., around the lake. Such a storage would make possible the development of 600,000 hp. on the River Saguenay, about the town of Joncquières. Lake St. John has an area of 350 sq.mi., and drains a watershed of 30,000 sq.mi.

The Commission has also made a complete study of the possibilities of creating a storage reservoir in Lake Kenogami, west of the towns of Chicoutimi and Kenogami. This lake has an area of 12 sq.mi., and there is at present partial regulation under the control of the Chicoutimi Pulp Co. Lake Kenogami has two outlets; one into the River Chicoutimi which flows into the Saguenay at Chicoutimi about 10 mi. from Kenogami; the other outlet is through the River Aux Sables which flows into the Saguenay at Kenogami. Lake Kenogami is about 475 ft. above the level of the Saguenay River; its two outlets are well provided with falls and rapids. On the Chicoutimi River, water powers have been developed and are being used by the Chicoutimi Pulp Co. to operate their large pulp mills. On the River Aux Sables, Price Brothers, Ltd., have developed water powers for the operation of their pulp and paper mills at Kenogami. The cost of storage in Lake Kenogami was estimated at $1,800,000 in 1916 but, under present conditions, it is believed that its cost would be nearly $3,000,000. The question as to whether this work should be carried out or not is now under consideration.

Among the other activities of the Quebec Streams Commission, there is the study of a certain number of undeveloped water powers; namely, on the St. Maurice River, on the St. François River, on Bell and Harricana Rivers in the Abitibi district, and on the Manicouagan, Aux Outardes and Natashquan Rivers on the north shore of the St. Lawrence.

The Commission has also started systematic gagings of a certain number of rivers in the province. This field of investigation is being enlarged every year, and it is the aim of the Commission to extend it over the whole of the province.

Beneficial results have been already obtained through the water conservation policy inaugurated by the government. Very important industries have located in the St. Maurice valley; namely, at Shawinigan and Three Rivers, owing to the large increase in the power possibilities of this valley. On the River St. François, plants are now being constructed at Drummondville, Richmond and Sherbrooke, in which several million dollars must be invested and where two or three thousand hands will be given employment.

The money invested by the province in the conservation of water is a very profitable investment, not only through the charges which are made to the power companies using the water, but through the industrial prosperity which the policy will contribute largely to bring here.

"Boils" in Asphaltic Pavement Caused by Metals in Fill Beneath

WITHIN a few months after an asphalt pavement was put down in the City of Bakersfield, Cal., peculiar round swellings or "boils" began to appear at frequent intervals in one section of the work. The pavement seemed to be sound in every respect except for this stretch of about 1,000 ft. long, in which scores of the boils slowly but steadily rose. The boils grew until the larger ones were 2 or 3 in. high at the center and had disturbed the pavement within a circle about 2 ft. in diameter. The smaller ones were sharper. All of them showed central cracks, more or less radial. In fact, radial cracks usually appeared with the first perceptible swelling.

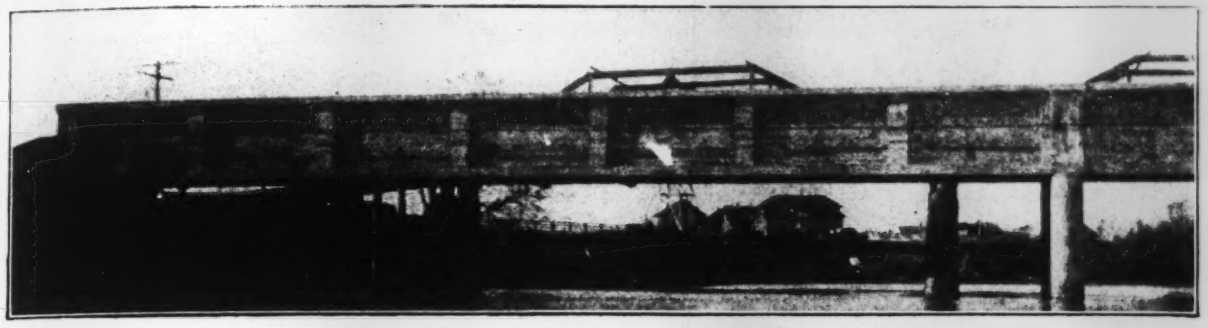
When one of the largest of the boils was opened a lens-shaped mass of copper sulphate crystals was found. In others were found crystal formations of various sizes and stages of development, some with a nucleus of copper or zinc still remaining in metallic form. After removing these causes of the disturbance and after patching the pavement there was no further trouble. Some of the boils which were not opened have since somewhat subsided. The pavement has now been down about 2 years.

The suggestion of a possible cause, as made by R. W. Whitaker, city engineer, is as follows: This particular stretch of the paving was laid on a fill 1 to 2 ft. deep placed over an old oiled surface. Material for the fill, the typical sandy formation of this part of the valley, was taken from a spot on which a garage, full of automobiles, burned to the ground about 10 years ago. Evidently metal scraps were left in the ground at the site of this fire. Before placing the paving on the fill the latter was well soaked and it may be that the old oiled surface below kept the moisture from escaping readily. Thus with impervious surfaces below and above and with the extreme heat of the sun's rays on black pavement, something was leached from the asphalt, perhaps a sulphur compound, which attacked the metal.

The pavement has a 4-in. asphaltic concrete base and a 1½-in. sheet asphalt top, the asphalt in both cases being 70-80 penetration, refined from California petroleum. The interesting question is: What attacked the metal?

Status of Railroad Compensation Contracts

The status of compensation contracts between the Government and the railroad corporations as of Jan. 1, 1920, is outlined in the recent report of the Division of Law of the Railroad Administration. Of the total annual rental of $917,000,000 paid by the Government to the companies, $717,153,182, or 7 per cent of the total annual rental, was covered in 232 contracts as of Jan. 1, including two with lump sum payments and the remainder providing for annual rentals. In addition there were reported 133 "'co-operative" contracts with short-line railroads. Claims for compensation have been filed by 124 railroad companies aggregating $92,318,789.39, and of these 35 claims have been allowed in part, totaling $7,493,618.53, 67 have been denied, eight have been withdrawn, leaving 14 claims pending, totaling $9,324,288.15. In seven cases boards of referees have been appointed and one decision had been made at the time of the report.



Longest Concrete Girder Bridge Is Built in California

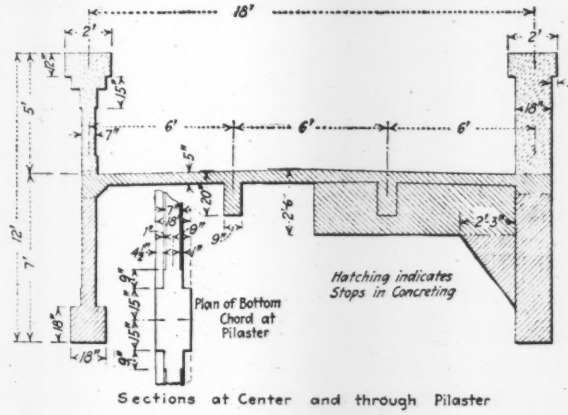
Has Two 142-Ft. Spans and Is Designed To Carry One Fifteen-Ton Roller or Uniform Load of 70 Lb. per Sq.Ft.—Proves Cheaper Than Concrete Arch or Steel Trusses — Proximity to Sea Requires Protection Against Corrosion

TWO record-breaking concrete girder spans make up a new highway bridge across the Salt River in Humboldt County, Cal. Each span is 142 ft. between centers of supports, which is far in excess of the longest reinforced-concrete girders hitherto built. Investigation shows no previous bridge girder over 75 ft. span and few interior girders of even that length, though there is a record of roof girders in the Leonardt Warehouse in Los Angeles with spans of 102 ft. (see *Engineering News*, April 20, 1905, p. 422).

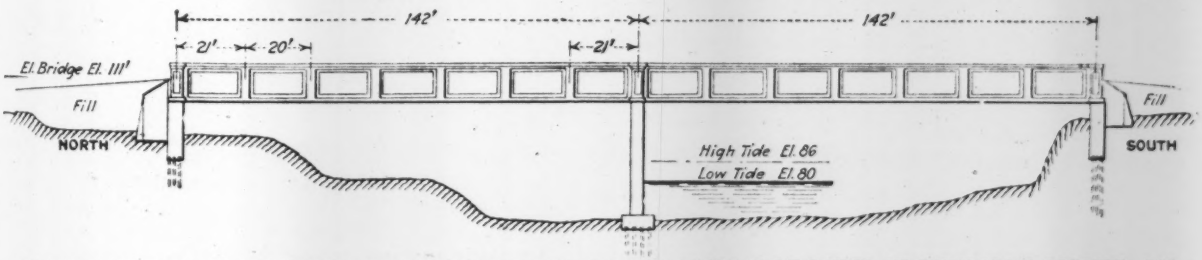
Reinforced-concrete girders were adopted for the Salt River bridge in preference to a concrete arch because of the greater clearance and lower cost of the girders. It was necessary on account of the location near the coast where salt fogs are common to have the steel protected against corrosion, so steel trusses were not considered in the design. It is stated that an arch bridge of the same length with solid rock abutments built under almost identical conditions in the same general location cost $160 per lin.ft. as against $135 per lin.ft. for the girder bridge.

Views and drawings of the bridge accompany this article. The two spans are identical. Each consists of two concrete girders 12 ft. deep carrying at 20-ft. intervals (21-ft. spans at each end) floor beams between which the 5-in. concrete floor is carried on 9 x 20-in. reinforced-concrete stringers spaced at the third points of the floor beams. The main section of the girder is 7 in. thick, enlarging by steps to 24 in. at the top and 18 in. at the bottom, and with pilasters opposite the floor beams stepping up to a maximum width of 30 in. and thickness of 18 in.

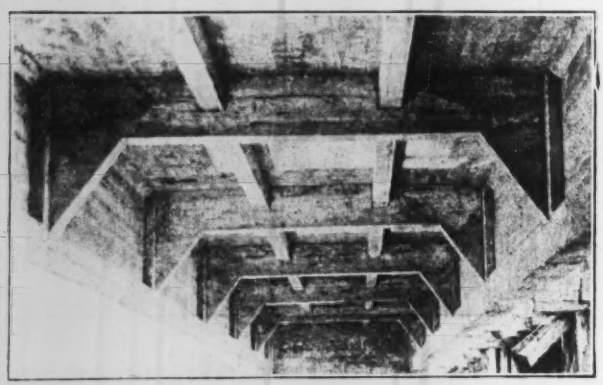
Each main girder is figured as a straight girder loaded for floor-beam reaction. The steel, however, is continuous over the center pier, no expansion joint being provided at this point. The design was made for a uniform live-load of 70 lb. per sq.ft. over the entire road surface or a 15-ton road roller in accordance with the theory and tabulation in Ketchum's "Design of Highway Bridges." As classified in that text, this bridge would be classed "E" ordinary county highway bridges." Calculation of stresses under dead- and live-load gives a maximum compression of 1,100 lb. per sq.in. and a maximum shear of 226 lb. per sq.in. in the main girders. Concrete is expected to carry only 60 lb. of the shear, steel being provided for the remainder. Calculated extreme fiber stresses of the steel in the girder range from 12,000 lb. in the top of the bottom flange to 16,000 lb. per sq.in. in the lowest bar. The 21-ft. stringers were stressed less than the main girders. Here the 15-ton road roller stresses govern, while in the design of the main girders the distributed load gave maximum stress. In the stringers the maximum fiber stress of the concrete is 350 lb. per sq.in. In the steel a maximum fiber stress of 16,000 lb. per



Sections at Center and through Pilaster



GENERAL DETAILS OF CONCRETE BRIDGE WITH 142-FT. SPANS ACROSS SALT RIVER IN HUMBOLDT COUNTY, CAL.

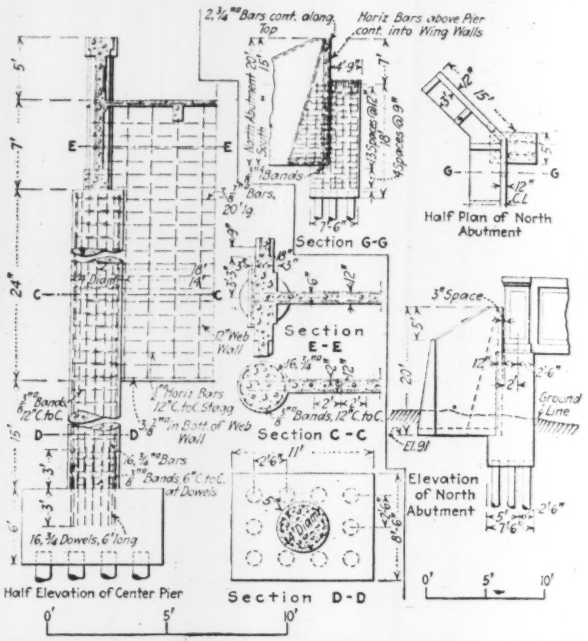


LOOKING UNDER THE SALT RIVER BRIDGE SHOWING A DETAIL OF FLOOR SYSTEM

sq.in. was permitted and the shear is 145 lb. net section. Because of the likelihood of rusting and corrosion, too, it was decided not to use roller bearings to carry the expansion movement of the girders. Instead a thin sheet of asphalt was poured at each end and 4-in. latitude allowed for expansion and contraction.

The influence of concrete ship design and construction is noticeable in the layout of the reinforcement and in placing the concrete. Steel bars, it will be seen from the sections, have to be distributed closely through the flanges of the girders, and, as in the concrete ships, they are separated with spacers. Placing the concrete, too, was facilitated by the use of pneumatic hammer on the forms, as was done in the Government concrete ships.

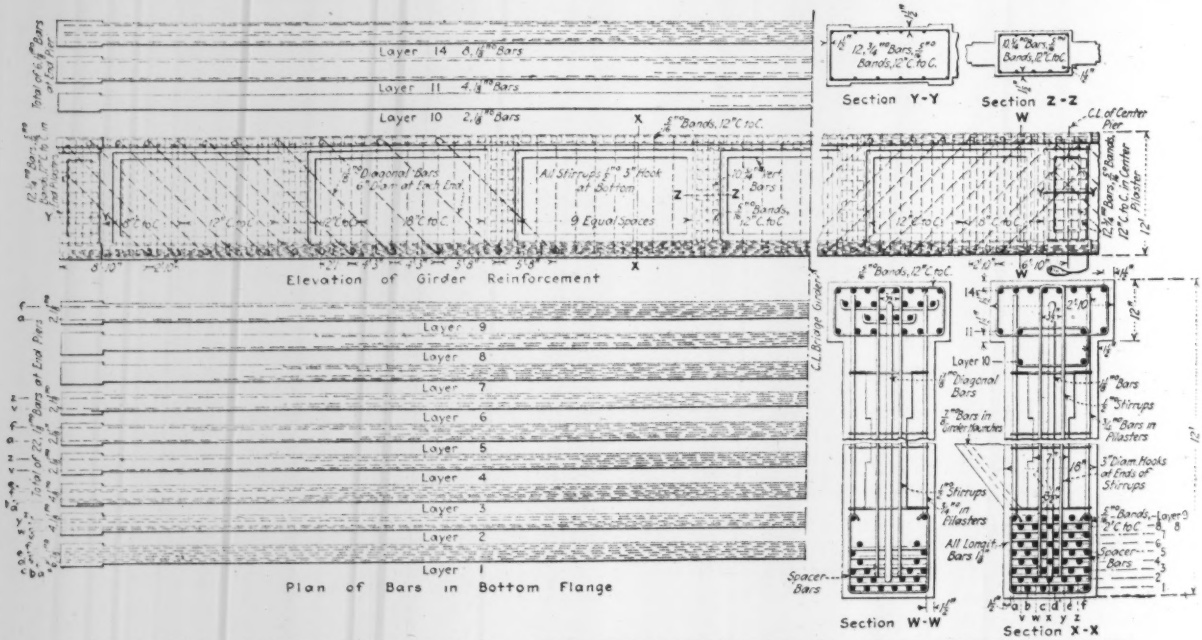
Reinforcement in the girder was built up to shape in the forms. An opening was left along the upper side of the bottom flange of the forms through which to place the bars below that level, and each layer was fastened as it was placed. The steel used in top and bottom flanges is all 1¼-in. bars, plain rounds, which were delivered on the job in lengths up to 80 ft. In



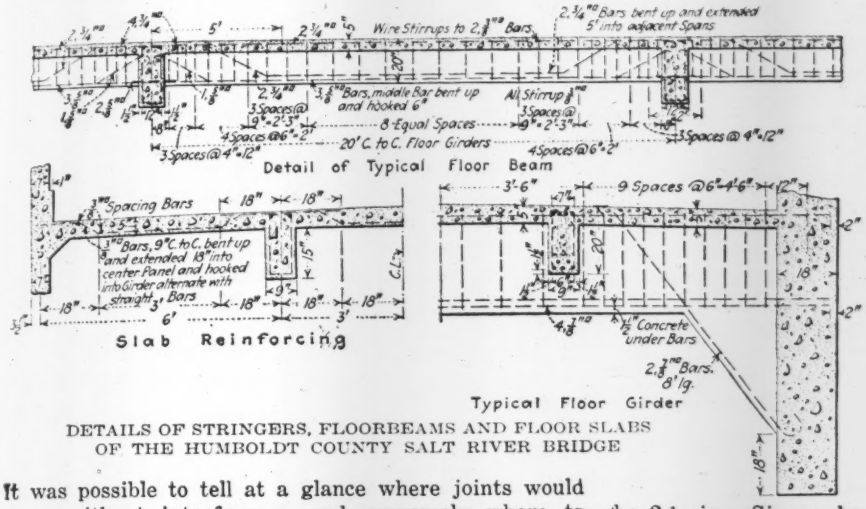
DETAILS OF ABUTMENTS AND CENTER PIER OF SALT RIVER BRIDGE

order to avoid the possibility of confusion in placing the steel and to insure a location of joints that would give a sufficient cross-section of continuous steel at any point, there was added to the blueprint an extra sheet on which was plotted the length and location of every longitudinal bar in top and bottom flanges.

A reproduction of this drawing is given in one of the drawings herewith. In the bottom flange, for example, there are nine layers of six and five bars each. Each layer was numbered and the successive runs of bars in each layer were lettered. By laying off the length of these bars to scale, one above another,



MAIN GIRDER DETAILS OF THE LONGEST REINFORCED-CONCRETE GIRDER, 142 FT. CENTER TO CENTER
(Note method of showing arrangement of flange steel reinforcement.)


Wire Stirrups to 2⅞" Bars
2¾" Bars bent up and extended 5' into adjacent Spans
Bars, middle Bar bent up and hooked 6"
All Stirrup ⅜"
8 Equal Spaces
20' C. to C. Floor Girders
Detail of Typical Floor Beam
Spacing Bars
Bars, 9" C. to C. bent up and extended 18" into center Panel and hooked into Girder alternate with straight Bars
Slab Reinforcing
9 Spaces @6"-4'6"
½" Concrete under Bars
2⅞" Bars, 8' lg.
Typical Floor Girder

DETAILS OF STRINGERS, FLOORBEAMS AND FLOOR SLABS OF THE HUMBOLDT COUNTY SALT RIVER BRIDGE

It was possible to tell at a glance where joints would come without interference, and conversely where to put the steel when the time came to sort it out and assemble it on the job. Thus on this special sheet not only was each run of steel identified by letter and number, but the exact length of each piece and its longitudinal position were also specified. In order to secure the necessary amount of steel in all cross-sections without lap joints, joints were broken at such intervals that such joints could be used in all runs and still maintain the required amount of steel in all sections.

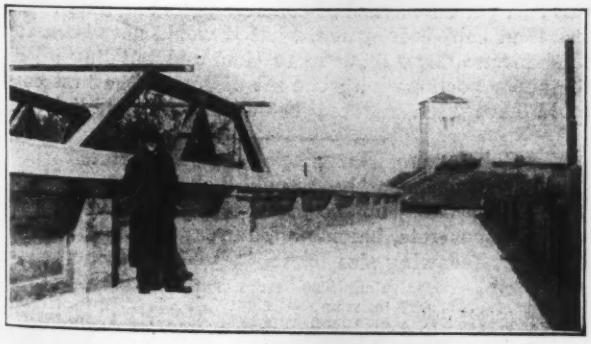
As indicated on one of the cross-sections, the concrete was poured in five successive stages. The lower halves of the girders were poured first, then the floor system, and finally the upper halves. Under this plan suitable places for making joints could be reached at the end of each day's continuous pouring. Each half of each girder was poured in one day and the floor system was poured in four sections in one day each.

Two grades of concrete were used on the job, one for the girders and one for the floor slabs and floor system. In the girders there was used a 1:4 mix, with the aggregate consisting of 1½ parts sand and 2½ parts gravel, the gravel ranging from ¾ in. as a maximum down to ¼ in., and the sand from ¼ in. to fines. In the floor system a 1:1½:4½ mix was used with the gravel up to 1½ in. maximum size. The 1:1½:2½ mix was found to test from 2,800 to 4,200 lb. per sq.in. in 28 days.

The falsework consisted of ordinary driven pile bents with sway bracing such as is used on railroad trestles. Square timber caps were used and above the caps the supports were shored up on shims so that the forms could be accurately lined up just before pouring concrete. The unsupported length of piles varied from 10 to 25 ft. The operations were carried on from one end of the bridge instead of both ends as was originally planned. This was due to the failure of the old bridge nearby, which prevented the contractor from delivering materials on the far side of the stream.

Using the design figures as stated before with a section modulus of 15, the center deflection of the girders for full load was calculated to be $2\frac{1}{16}$ in. Six weeks after the forms had been removed a deflection of 1¼ in. in the center of the span was reported. Specifications called for a 2-in. camber.

The bridge was designed by H. J. Brunnier, consulting engineer, San Francisco, and constructed by the Englehart Paving & Construction Co. of Eureka under a lump-sum contract of $25,250. A. J. Logan is county surveyor of Humboldt County.



ROADWAY OF THE SALT RIVER CONCRETE GIRDER BRIDGE

Series of Dry Years Bring Serious Drought in California

CALIFORNIA faces one of the most serious situations in years through the shortage of water, according to statements by the California State Power Administrator and by the San Francisco Forecaster of the U. S. Weather Bureau. The following statements are extracted from recent bulletins from these two officials:

In the high Sierras where there should be 130 in. of snow at the 7,000-ft. level, there were only 23 in. on Feb. 11 and at the 5,000-ft. level no snow at all. Rivers and reservoirs which would normally be full are as low as after a hot, dry summer. Irrigationists who pump water will this year have to draw from a water table perhaps twice as far below the surface as normally and the increased amount of power which they will require for this purpose will cost more per unit because or the shortage which the hydro-electric companies face. Because of the extreme low water in the two large rivers of the State, salt water has found its way farther upstream and towns which took their water supplies from these rivers are being forced to seek other sources.

The power shortage which is now inevitable will become acute early in June and will not be relieved until the rains commence in the fall or winter of 1920. The steam reserve plants of the hydro-electric companies were all worked to capacity last year and it is not to be expected that they can produce much additional power this year. On the other hand, the hydro-electric power generated will be less and the demand is expected to be considerably greater than the 1919 demand.

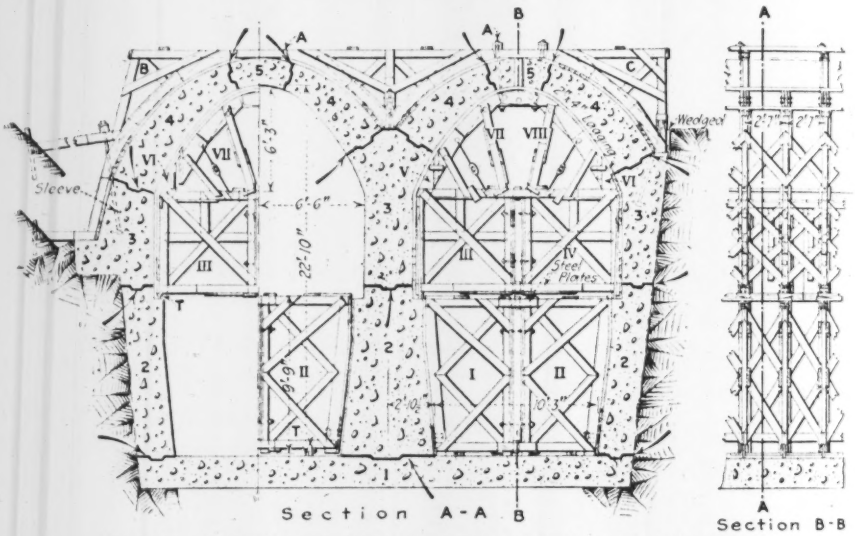
Already the power companies are refusing to take on load which may prove embarrassing during the shortage. This will necessarily retard industrial development in general, and will be a very serious setback to plans for new ventures such as the electrification of railroads.

Form Design for Miami Flood-Control Dam Conduits

End-Supported Timber Forms Trussed for Horizontal and Vertical Load on 30-Foot Span—Cost Less Than Steel

FORM design for the twin-outlet conduits of the detention dams of the Miami Valley flood protection works at Englewood and Germantown, Ohio, involved these principal factors: (1 Low cost of construction; (2) provision for quick shifting; (3) provision for collapsibility; (4) flexural rigidity with end supports only, and, (5) ability to endure repeated use. Timber construction best met the requirements, according to Walter B. Smith, designing engineer, who describes the forms in the October issue of the *Miami Conservancy Bulletin.* The drawing shows the design and construction adopted.

The construction plan on which the form design was based was that concreting should proceed in 30-ft. longitudinal sections and in cross-sectional units arranged as indicated by arabic numerals on the drawing. Division of the arches each into three sections and five joints was adopted to avoid high temperature stresses which would have occurred had fixed arches been used. These joints made the construction of the arches much slower and more expensive, but this additional cost was believed worth while in view of the added safety gained. The plan was also to concrete the two conduits of a pair simultaneously.



FORMS FOR GERMANTOWN AND ENGLEWOOD DAM CONDUITS, MIAMI CONSERVANCY DISTRICT

The number of forms to be provided was based on the estimate that one floor section could be placed every two days, one lower wall section every three days, and one upper side wall and arch section every six days. One set of lower forms and two sets of upper forms were, therefore, provided. It was planned to set up one set of upper forms over the first completed section of the lower portion as soon as it had set two weeks, and to start a second set of upper forms when the lower forms, which began concreting at one end of the conduits, had passed the center line of the dam. By this schedule the upper and lower parts of the conduit would be finished about the same time. At first the schedule was realized, but afterwards the labor scarcity because of the war caused some lagging in the progress of the upper half of the conduit. The slower relative speed in building the arch sections was in part due to the several units in which the arch was concreted.

As indicated by the drawing, the lower forms were built in two sections and the upper forms in six sections. All sections were long enough to furnish end bearings and leave a clear length of 30 ft. for concreting. Having support only at the ends, sections I, II, III and IV were designed as trussed girders to sustain both horizontal and vertical load. The vertical spaces between I and II and between III and IV permitted the two sections of a pair to be pushed apart or pulled together by means of bolts and wedges and this collapsed and expanded for shifting and resetting. Carriage ahead was accomplished by placing truck wheels and casters as indicated at T and rolling the form along on the finished concrete.

Four separate segments made up the arch forms. Segments V and VI were rigidly fastened to sections III and IV and segments VII and VIII were hinged at the crown and supported on sections III and and IV by radial posts. The two crown segments were collapsed and expanded by means of wedges at the posts and by rods with turnbuckles.

Sections I and II complete weighed 10 tons. At Englewood dam these sections were set up and used 22 times in succession and at Germantown dam 18 times. Except that the lagging showed cuts caused by spading the concrete, the forms were in good condition when the work was finished. A 30-ft. section of the complete upper form weighed 15 tons. There being two sets of upper forms for each conduit tube, each set was used only about half as many times as was a set of lower forms.

The exterior arch forms were comparatively simple. They were built and handled in three sections A, B and C and were supported as shown by the drawings.

The cost of forms set in position for first pouring was 35c. per cubic yard of concrete placed against them, less than half, it is stated, what it would have been for steel forms. By taking more time and building all of the upper portions with one set of forms, the first cost could have been reduced below 25c. per cubic yard.

Reinforcing Bar Sizes To Be Restricted

Announcement has been made that on account of the need for speeding up the production of steel reinforcement for concrete, bar manufacturers will only roll for stock the following size bars:

Area Sq.In.	Equivalent Size	Area Sq.In	Equivalent Size
0.110	⅜ in. round	0.601	¾ in. round
0.196	½ in. round	0.785	1 in. round
0.250	½ in. square	1.000	1 in. square
0.307	⅝ in. round	1.265	1¼ in. square
0.440	⅞ in. round	1.560	1¼ in. square

All other sizes will be considered special.

Emergency Engineering After a Georgia Flood

Two Bridges Connecting Parts of West Point Were Washed Out, But Crossing Later Made by Ferries

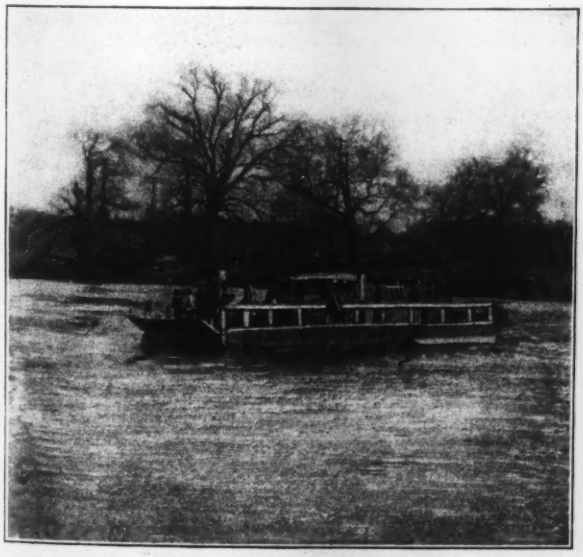
By Carl E. Wideberg
Auburn, Ala.

EXTRAORDINARY high water in the Chattahoochee River the second week in December, 1919, caused a great deal of damage in the City of West Point, Ga., which lies on both sides of the river. The two bridges connecting the two parts of the city were both washed away and traffic communication as well as water-supply was cut off. Immediate steps had to be taken to restore livable conditions.

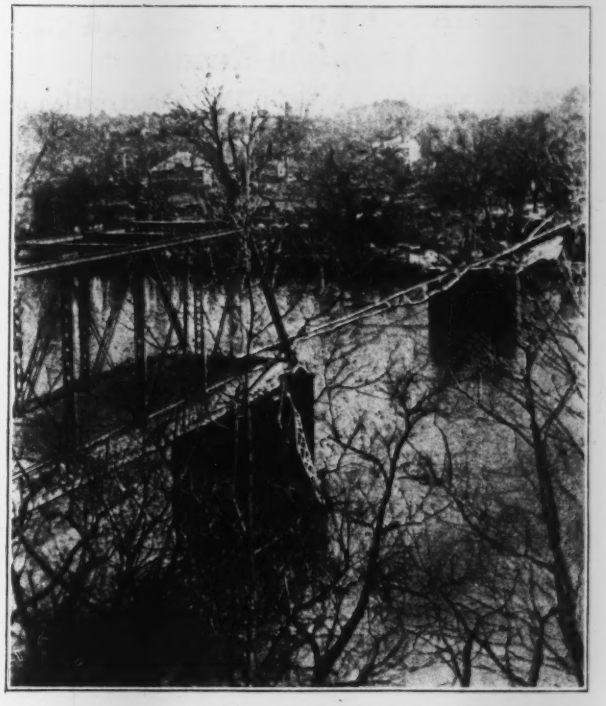
An 8-in. water main was carried on the steel highway bridges from the west side of the town, where the reservoir was situated, over the river to the eastern portion of the town. When the spans were washed away this cast-iron pipe also snapped, and before the flow of water was stopped, all the water in the reservoir had been drained out, thus leaving both parts of the town without water. The flood had crippled the pumping station so that no more water could be pumped into the reservoir. Drinking water, therefore, had to be distilled. The flood also put the electric light plant out of commission.

As soon as the water subsided it became evident that communication and means of transportation had to be established between the two parts of the town. A 4-in. water-main was connected to the 8-in. main on the western bank and carried across the river suspended from a wire cable and also resting on the piers of the bridge which were still standing. An ærial boardwalk was also fastened to the cable, as can be seen in one of the views herewith.

The highway bridge had connected portions of the New York-New Orleans highway and carried a very heavy traffic. To accommodate this traffic two flatboats were immediately constructed for ferries at a cost of $1,500 apiece and put in commission. The current was used as a method of propulsion for these ferryboats, acocrding to the cableway method for such crossings.



EMERGENCY CURRENT-DRAWN FERRYBOAT USED AT WEST POINT, GA.



WATERMAIN AND FOOTWAY CARRIED ACROSS BRIDGE PIERS AFTER A FLOOD

In addition to these ferries, West Point is soon to have a military ponton bridge across the Chattahoochee. Through the efforts of Congressmen, the people have been able to get this from Congress. It is intended to have the eastbound and westbound traffic use the bridge alternately during periods of the day, as it will be impossible for both to cross at the same time. The bridge will be built by a detail from the 7th Engineers, U. S. A., now stationed at Camp Gordon, Ga.

Irrigation Projects in the Punjab

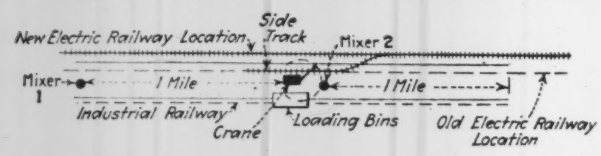
Five proposed irrigation schemes which will solve the problem of famine in the Punjab Province in the northern part of India involve the construction of the "highest" dam, a lake barrage, five weirs across formidable rivers and nine new main canals, as reported through commerce reports in the *Reclamation Record* for February. The cost is estimated at $110,000,000 for irrigating 6,000,000 acres.

The projected dam is 395 ft. high and is located on the Sutlej River in the Bhajra gorge, 40 miles above Rupar. It will impound 2,500,000 acre-feet of water which will be used for extensions and additions to existing works. Two weirs on the old Sutlej Valley project will enable four new canals to be taken off and supply 3,000,000 acres. A small scheme is the Wular Lake Barrage, in Kashmir, to store water from Jhelum River during the monsoon for use in winter. A fourth project would improve the semi-perrenial canals of the Sidhnai series and extend the acreage in the Jhanj district. The fifth new Punjab project is a revival of the old idea of a weir across the Indus at Kalabagh and a canal serving 2,000,000 acres of land between the rivers of Jhelum and Indus.

Two Miles a Month Averaged on Michigan Road

Co-ordination Main Factor in Fast Construction of Heavy-Traffic Highway—Central Loading Plant and Two Mixers Used

CONSTRUCTION averaged two miles a month and attained a rate of one mile in eight days on a 10-in., 24-ft. integral-curb asphalt pavement completed this season on the main highway between Detroit and Mount Clemens, Mich. Except that all operations were kept as completely mechanical as possible and at times, to insure progress, more equipment than was actually necessary was operated, the plant was unusual in no particular. Materials supply and plant operations were, however, kept very closely co-ordinated to secure full output of the mixing and placing outfits, two of which were operated from a central loading plant whose location was changed so as always to keep the haul not to exceed one mile.



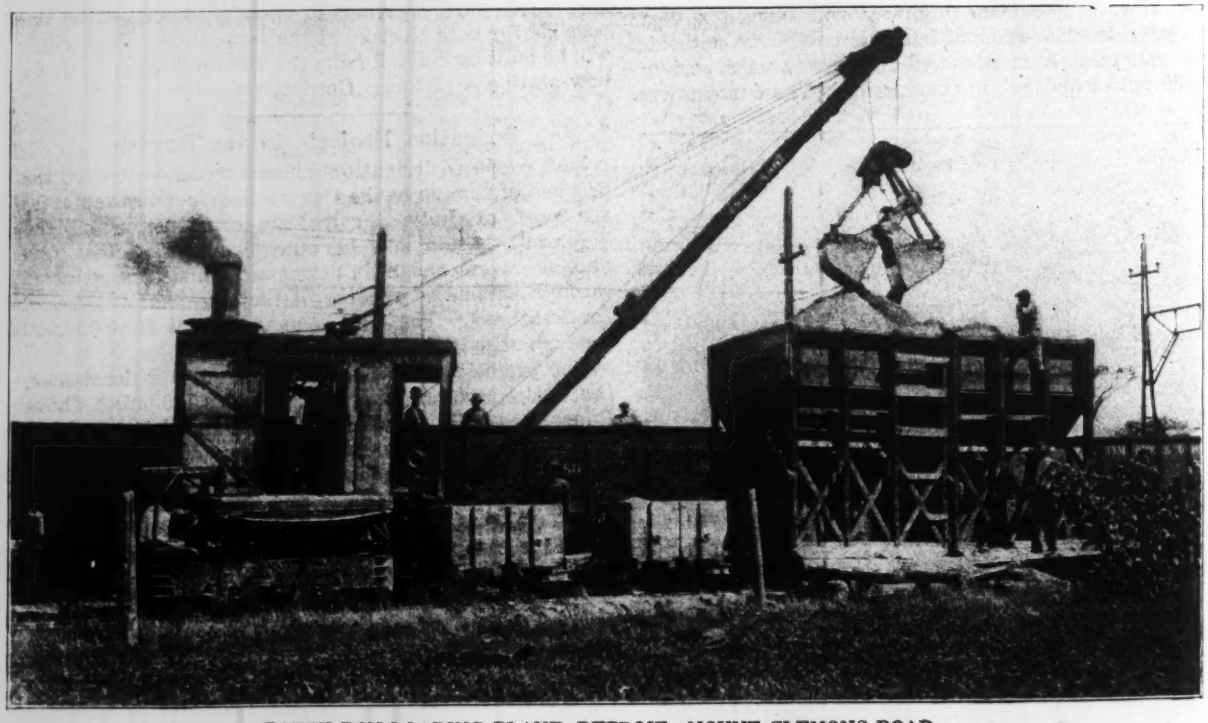
LOADING-PLANT AND INDUSTRIAL-RAILWAY LAYOUT

The contract, awarded early last spring to the Detroit Asphalt Paving Co., called for the construction of 10½ mi. of 24-ft. pavement consisting of a 7-in. concrete base, with a 3-in. integral curb and a 3-in. natural-lake asphalt wearing surface and having a 4-ft. shoulder on each side. Besides the heavy character of the work to be prepared for, the contractor had to meet a requirement for the completion of the road in one season. The governing operation was the construction of the concrete base running about ⅝ cu.yd. a lineal foot.

Materials were received on the outer belt railway at Detroit, where an interchange track was constructed allowing cars to be placed on interurban electric line rails. The interurban line paralleled the new road for its entire length. Simultaneously with the road work, the interurban line was constructing new tracks along its new right-of-way and gradually removing the old tracks from the highway. Advantage was taken of this circumstance by the contractor. At intervals of two miles he established an unloading point, leaving in at these points enough of the old interurban tracks to accommodate the handling of 16 cars.

A proportioned gravel-and-sand mixture was purchased and delivered in gondola cars at the unloading point. Here were placed two locomotive cranes with ¾-cu.yd. clamshells which unloaded the cars into elevated bins of approximately 30 cu.yd. capacity. The unloading plant crew comprised 2 locomotive crane operators and 2 firemen; 2 men handling and loading cement; 2 men unloading from pockets into batch boxes, and 1 man caring for cement sacks and oiling cars. By careful management the contractor was able to maintain a regular daily shipment of materials and thus avoid the necessity for maintaining a stock pile on the job.

Trains of industrial cars carrying batch boxes transported the material from the loading plant to the mixers. The industrial track ran a mile each way from the loading plant. Two paving mixers with attached cranes for handling the batch boxes were operated. One mixer started at the end of one track a mile from the unloading plant and worked toward it, and the second mixer started at the unloading plant and worked away from it to the end of the track a mile away. By this arrangement the average haul to each mixer was one-half mile. For transporting water pipe and other materials beyond



BATCH-BOX-LOADING PLANT, DETROIT—MOUNT CLEMONS ROAD

the industrial track a Ford tractor and a five-ton rubber-tire trailer were employed.

Four trains of eight cars were operated by four 3-ton gasoline locomotives. An extra train of eight cars was also always in service and under load on a passing track near the unloading plant. Each car carried two 18-cu.ft. batch boxes or a four-bag batch. The aggregate was run into the boxes directly from the overhead bins, and the cement in bags was placed on top of each box load. At the mixer the batch boxes are unloaded by the crane into the charging hopper and the bags of cement are untied and emptied by hand.

By the methods described the contractor was able to complete five miles by the middle of July, and as the work terminated at Clinton River, over which a reinforced-concrete bridge is being built, it was found feasible to discontinue one mixer and complete the last five miles with the second outfit. When operating two mixers a complete mile of pavement was constructed in eight days, but the average for the whole operation has been two miles of road a month.

All work was under the direction of Thomas E. Currie, Detroit, Mich.

Illinois Waterway to Connect the Lakes and the Mississippi

AS THE construction by the State of Illinois of a waterway connecting the Chicago drainage canal with the Illinois River, to complete the link between the Great Lakes and the Mississippi, has been authorized by the U. S. War Department, there is interest in a brief review of the history of the project given at the recent annual meeting of the Illinois Society of Engineers, by M. G. Barnes, chief engineer of the waterways division of the State Department of Public Works and Buildings.

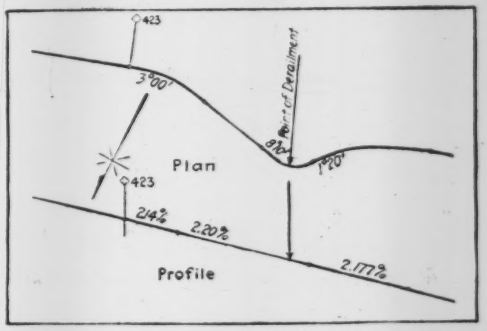
In 1908, the people of Illinois voted for an amendment to the State constitution to permit the expenditure of $20,000,000 for this waterway link of 65 miles. One of the first plans was for a canal having 14 ft. of water, with future development for 24 ft. draft and having several water-power plants, but the cost was prohibitive. A board of engineers appointed by Congress opposed a 14-ft. depth and a channel sufficient for lake and ocean vessels. (See *Engineering News*, March 2, 1911, p. 269). A later board of engineers appointed by Governor Dunne advocated an 8-ft. waterway with locks 250 x 45 ft. and in 1915 a bill appropriating $5,000,000 toward its construction was passed by the State legislature. The Secretary of War, however, at that time refused to grant a permit for the work in the Illinois River.

This was the state of affairs when Gov. Lowden came into office. After the reorganization of the State department of public works and the creation of a division of waterways as a branch of this department, Mr. Barnes was appointed to make further investigation. He arrived at the conclusion that greater advantage would result from a barge canal or waterway, since the cost of transportation would be less than with large steamers on inland waters and the barges could serve individual shippers. Further, the Mississippi river cannot accommodate deep-draft vessels. His plans provided also for water-power development.

On the basis of this report the legislature of 1919 passed a waterway act providing for locks 110 x 600 ft. with 14 ft. of water on the sills, while the connecting pools or channels were to have a minimum bottom width of 150 ft. and a depth of 8 ft. in earth and 10 ft. in rock. This arrangement provides for the possibility of a future 14-ft. channel, while the locks are large enough for fleets of barges having an aggregate capacity of 7500 tons. This act repealed the former act of 1915. No detailed plans have been made, but the route will utilize the Illinois river from Utica, Ill., and then up the Des Plaines river to the drainage canal at Lockport. There will be four or five dams and locks, as well as a short stretch of cut-off canal. The cost is estimated to come within the $20,000,000 bond issue authorized for this purpose in 1908.

Speed Too Great for Elevation of Outer Rail Caused Derailment

IN THE current report of the Bureau of Safety of the Interstate Commerce Commission on the derailment on the Southern Pacific R.R., near Vincent, Cal., on Oct. 29, 1919, the statement is made that the "accident was caused by excessive speed, the rate of speed permitted over that part of the road being too great for the existing elevation on the curve where derailment occurred." On the single-track line between Mojave and Augus, where trains are operated by time-table, train orders and automatic block signals, there is a 2 per cent grade descending eastward from Vincent to the point of accident, a distance of almost exactly three miles, where



DERAILMENT OCCURRED AT MID-POINT OF 8° 10′ CURVE ON 2.2% DOWNGRADE

derailment occurred 500 ft. from the beginning of an 8 deg. 10 min. curve to the left, separated by 1,300 ft. of tangent from a 3 deg. curve to the right over which the train had passed. The track is laid with 90-lb. rails, 33 ft. in length, double spiked, with an average of 18 ties to the rail, fully tie-plated. The ballast is of gravel.

The train, which consisted of two wooden baggage cars, five steel coaches, one tourist car, one dining car, and three Pullman sleeping cars, was operated under time-table rule to 30 miles an hour from Vincent for a distance of 1½ miles, but from that point to a distance approximately 3½ miles past the point of accident the time-table rule permitted passenger trains to run 40 miles an hour. The report of the Bureau of Safety says:

"It is believed that the track conditions existing at this point do not afford an adequate margin of safety for a speed of 40 miles an hour . . . . the track was in good alignment, surface and gage, the variations in gage and elevation being slight. The elevation, how-

ever, was insufficient for the maximum rate of speed permitted. According to the measurements of the division engineer the elevations are from 4 to 4⅛ in. According to the recommended practice of the American Railway Engineering Association, the theoretical elevation of the outer rail on an 8 deg. 10 min. curve, if trains are to be operated over it at a speed of 40 miles an hour, should be slightly over 8½ in." The testimony of employees, according to the report, indicates that the speed was about 35 miles an hour at the time of the derailment and "the statements of one of them indicated that it was in excess of that amount."

The locomotive was not overturned but came to rest in an upright position on the right side of the track about 270 ft. from the point of derailment and 40 ft. from the track, outside of the curve. The report states that "examination of the track disclosed that the first mark of the derailment was on the outside rail where a wheel, apparently one of the wheels of the engine, had mounted the rail. This mark extended diagonally across the rail a distance of 4 ft. This mark on the roadbed outside of the rail was 6 ft. beyond the point where the wheel left the ball of the rail and 12 in. from the gage side of the rail. This mark continued to lead off to the right and down the 10-ft. embankment on which the track was laid at this point. This mark on the ties between the rails was 35 ft. east of the point where the first mark appeared on the opposite rail, indicating that the wheels on the left side of the engine had been raised from the track and did not come down within that distance. Beginning 70 ft. beyond the first marks, the track was torn up for a distance of about 200 ft."

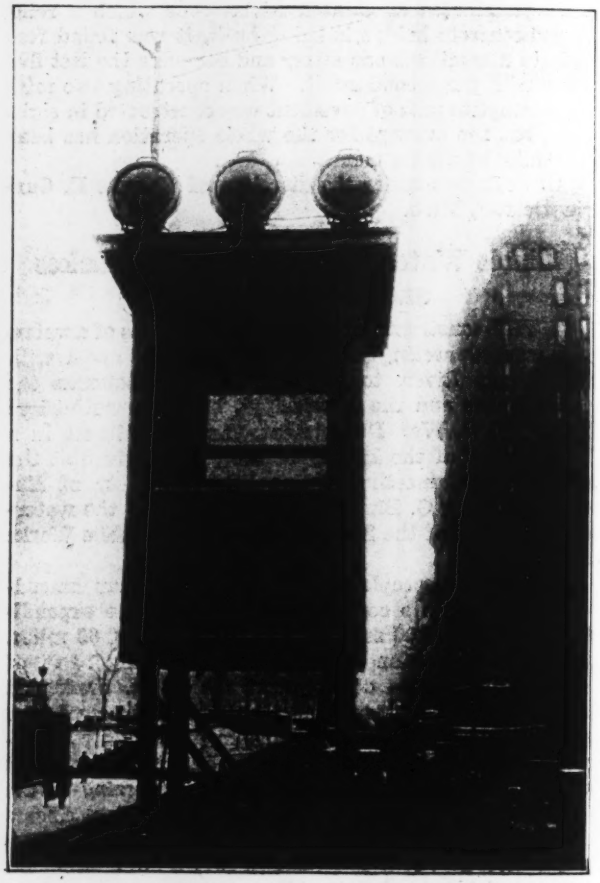
No evidence appears to have been found that the defects of equipment contributed to the accident. The statement is made that the "marks on the ties . . . . indicate that when the wheels of the engine first mounted the rail the engine was raised clear of the track on the left side and did not settle back until it had reached a point 35 ft. beyond the first marks. This indicates that the speed of the train was excessive at the time of derailment. . . . . With an elevation of 4 in. the maximum speed allowed should be only slightly over 27 miles an hour. While it is true that the overturning speed of a train on a curve of the degree and elevation here under consideration is much greater than 27 miles an hour, nevertheless overturning speeds are entirely matters of calculation and theory, whereas the speeds shown as safe speeds are more or less matters of common knowledge based on practical experience. The speed of a train seldom reaches the point where it actually overturns; long before such a speed is reached the speed is sufficient to cause the equipment to rock back and forth until finally the wheel climbs the rail and results in derailing the train. This was evidently the result . . . . . as none of the equipment overturned." The conclusion is drawn that "had the speed of the trains on this curve been restricted in accordance with the recommended practice of the American Railway Engineering Association for the existing elevation, this action would not have occurred."

The derailment resulted in the death of two employees, two trespassers and one passenger, and the injury of three employees, one trespasser and 158 passengers. The accident was investigated jointly by the Bureau of Safety of the Interstate Commerce Commission and the California State Railway Commission.

One-Way Traffic on 5th Ave. To Be Controlled by Signal Towers

Six Lines of Vehicles Will Move South Halting for 1 Minute at 1½ Minute Intervals

AS SOON as snow from the recent severe storm is sufficiently cleared from the streets the Police Department of New York City will introduce an innovation in the regulation of street traffic on Fifth and Park Aves., between 34th and 57th Sts., which, it is expected by Special Deputy Police Commissioner John A. Harriss, in charge of traffic, will serve to relieve existing



FIFTH AVE. TRAFFIC SIGNAL TOWER WITH RED, WHITE AND GREEN FLASHLIGHTS

congestion. The plan is claimed to be the first of its kind to be put into effect on such an important thoroughfare, being the introduction there of one-way traffic which, heretofore, has been confined to narrow streets of much less travel. Fifth Ave. accommodates six lines of traffic. Beginning at 10 a.m. and continuing until 5 p.m., and between the cross streets mentioned, traffic will move south only on Fifth Ave. and north only on Park Ave., thus forming what may be termed a belt line of rotary traffic. Traffic on Madison Ave., which bisects the belt-line area, and on Sixth Ave. will be maintained as two-way traffic.

Police signal towers have been erected at 57th St., 50th, 42d, 38th and 34th Sts., similar to signal towers on the railroads, from which the movement of traffic

on Fifth Ave. and cross streets will be controlled by flashlights, telephone and push-button signals, operating between the towers and to be observed by the traffic officers also at the intersection semaphores.

The floor of each tower is 12 ft. above the roadway to afford a clear view for their occupants. The signals to be flashed from the towers up and down the avenue, day and night, will be as follows:

RED SIGNAL: Traffic shall move on Fifth Ave. and all cross traffic from the side streets shall stop behind the building lines, or white limit lines when marked on the roadway.

YELLOW SIGNAL: All traffic on Fifth Ave. as well as side streets shall stop behind the building lines, or limit lines when marked on the roadway, so as to give clear intersections.

GREEN SIGNAL: Traffic from all side streets shall proceed.

These signals, which will be in operation from 9 a.m. until 12 midnight, will regulate not only the movement of vehicular traffic but also apply to all pedestrians in crossing the roadways, which they must do at the crossing. Before 10 a.m. and after 5 p.m. traffic on Fifth and Park Aves. will be both ways, but on Fifth Ave. under control of the men in the towers and at the other street intersections where the signals will be maintained. The same signals (red, yellow and green) will be alternately flashed, always having the same signification as stated.

By actual test it was found to have taken as long as 40 min. for a vehicle to go on Fifth Ave. from 57th to 34th Sts., or the reverse way, at certain times of the day. By the new regulation it is estimated that this annoying and costly delay will be reduced by more than 60 per cent, or to less than 10 min. between the points mentioned. This great reduction in time, as well as saving of wear and tear upon vehicles and inconvenience to individuals, will be accomplished by the continuous movement of traffic between the towers for periods of 1½ min. succeeded in turn by periods of 1 min. for the procedure of cross traffic. By conservative estimates, allowing 1½ min. between towers and intervals of 1 min. for cross traffic, a vehicle may start from 57th St. and reach 34th St., unless some unusual circumstance prevents, in from 7½ to 10 min. Towers will not be erected on Park Ave. for the present. All vehicles may stop at the curb on either side of the roadway on both Fifth and Park Aves. between 57th and 34th Sts., headed south, of course, on Fifth Ave., and between 34th and 57th Sts., headed north on Park Ave.

Greater safety, convenience and comfort to all drivers of vehicles, as well as to pedestrians and shoppers on Fifth Ave., it is believed, will be brought about by these regulations.

Large Drydock for St. John, N. B.

In the past five years there have been a great number of drydocks built in all parts of the world to accommodate the largest vessels now afloat. This means that the dock must be well over 1,000 ft. in length and 40 ft. in depth. The latest of such docks to be reported is being built by the government of the Dominion of Canada at St. John, N. B. It will be 1,150 ft. long, 133 ft. wide at coping, and 42 ft. deep over the sill at high tide. Provision is made for an intermediate sill and caisson to use separate portions of the dock 650 ft. and 500 ft. in length.

Why Engineers Should Be Put in Charge of Big Bridges

Protest Against Art Commission's Suggestion That Delaware Bridge Should Be Under Supervision of Architect

RESOLUTIONS of remonstrance have been addressed to Governor Sproul, of Pennsylvania, by the Society of Municipal Engineers, City of Philadelphia, following the publication of the letter of the State Art Commission recommending the appointment of an architect to have supervision of the proposed Delaware River bridge between Camden and Philadelphia. An abstract of this earlier letter appeared in *Engineering News-Record*, Jan. 29, 1920, p. 250. The engineers' resolutions are as follows:

Whereas, the local press of Jan. 26, 1920, has published extracts from a letter stated to have been forwarded to the Governor of the State of Pennsylvania, by the Secretary of the Pennsylvania State Art Commission, in which it is urged that an architect be appointed to direct the design of the Delaware River bridge; and

Whereas, these extracts imply that the question "what to build, meaning size and kind of structure," and the question "where, meaning location," are architectural and not engineering problems; that the structural problems are "but a detail"; that the success of the East River bridges is due to the work of architects and not of engineers; and that engineering direction of design results necessarily in structures offensive to the eye, and

Whereas, fair dealing, the safety of human life and the wise expenditure of public funds require that such misstatements and such false implications shall not go unanswered, therefore

Be it resolved, by the Society of Municipal Engineers of the City of Philadelphia, at their regular meeting of Jan. 28, 1920, that this Society subscribes to and sets forth the following facts:

1. That problems of traffic growth and traffic handling, of the development of communications, of property values and land damages, and similar problems involved in the approaches to a great bridge, and in an estimate of the capacity and arrangement needed in the bridge are predominantly the problems of the civil engineer.

2. That engineers are as keenly aware as any class of citizens, of the need for taste and beauty in structures erected in public view.

3. That where certain structures erected by engineers have offended the eye as in the cited case of the Rapid Transit Co. bridge across the Schuylkill River, and in the case of others which admittedly exist, the fault is oftenest chargeable not to the will of the engineer but to the refusal of his employing corporation or client to have any ideal considered save that of economy.

4. That the architect is, on the other hand, oftenest called in by clients who wish to pay the necessary price for taste and beauty, hence has worked under no such handicap; yet there abound examples of work done by prominent and successful architects in their own distinctive sphere—that of buildings and monuments—that are just as trenchantly criticized and condemned as are the bridges cited.

5. That any engineer competent to direct the design of so great a structure as the Delaware River bridge, is certainly aware that this great monument must be beautiful in its proportions and in all its details, and that the best of architectural collaboration should be had.

6. That the structural problems involved in the foundations and superstructure of this bridge, apparently destined to be greater in span than any now built, are comprehensible only to an engineer and will be sources of grave and protracted concern to those responsible for the immense risk of life and expenditure involved; that it would be a rash individual who would assume initiative and responsibility for

this unprecedented structure without a background of long training in the fundamental engineering principles underlying its design, and large experience in their application.

7. That the fitting relationship of the engineer and the architect engaged on such a design is indicated not by the uninformed assertions of the Art Commission that "the structural problem is but a detail," but by this: that without an architect the engineers could build this bridge and build it safely and by its very greatness of proportion and their well-meaning efforts it would even possess much beauty; but that without an engineer the greatest of architects would be paralyzed after he had made his first charcoal sketch.

8. That we know of no precedent in history, from the Brooklyn Bridge of John A. Roebling, engineer, to the most recent East River bridge, for any other scheme of organization than the placing of the engineer in supreme charge of the design, with the architect in the very honorable role of consultant; and that there is nothing in the training of the professional architect to justify a reversal of this practice. And be it further

Resolved, that this Society hopes to see the initiative and responsibility for the design of this bridge vested in a chief engineer who shall be a Philadelphian of high professional standing and broad vision, conversant with the city's past development and future trend, and experienced in meeting the legal and legislative problems that must arise; this chief engineer to have recourse to, and a voice in selecting, the best of engineering and architectural consultants, to the end that the bridge may be judiciously placed, safely built at a proper cost, and of notable beauty in proportion and detail. And be it further

Resolved, that this Resolution shall be transmitted to the Governors of the States of Pennsylvania and of New Jersey, and to the Mayors of the Cities of Philadelphia and of Camden, and shall be brought to the attention of the public and of other technical associations.

How Engineers Are Affiliated at Spokane

By J. C. Ralston

M. Am. Soc. C. E., Consulting Engineer, Spokane, Wash.

MINDFUL of the possibility that some members of the American Society of Civil Engineers may be in a quandary over the working out of the new doctrine of external relations as proposed by the Committee on Development, the writer as a partial answer presents the following outline of the methods successfully pursued by the engineers of the Spokane district for the past five years.

The local chapters of the founder societies in their individual capacities adhere strictly to the purely technical activities approved or authorized by the parent bodies. Thus complete indentity and autonomy are preserved, and the original constitutional object for "the advancement of engineering knowledge and practice and the maintenance of a high professional standard among its members" is never waived or relaxed. Hence there is no departure from the high ethical standards on which the premier societies were founded. Indeed, it may be said that the Spokane locals have jealously guarded the ark of the covenant and have never suffered any infraction of its principles.

But being desirous of extending the influence of the engineer in his external relations, and hopeful of becoming an "active force in economic, industrial and civic affairs" (to use the phrasing of the writer's original resolution in the Committee on Development), the several local chapters came together at the suggestion of J. B. Fiskin, Fel. A. I. E. E., Spokane, pooled their respective non-technical common interests and formed the Associated Engineers of Spokane. This organization became the local engineering council or clearing house. Corporate membership is acquired only by first becoming a member of one of the regular national socities and the payment of $2 annual dues. The executive board of the Associated Engineers is composed of four members each from the several local chapters. Each society chapter, irrespective of numbers, has an equal voice in association affairs. The board elects its own officers and appoints committees either from itself or from the general membership. If the business in hand seems to warrant it, the committee may be chosen from whichever profession is likely to be the most effective. A broad catholicity prevails, leading to the most representative and greatest effort.

Now, the Associated Engineers, embodying exclusively the non-technical aspirations and activites of the local chapters, find many worthy and proper fields requiring attention—fields which are not nebulous, impractical or utopian. Some of this work has been that of helping unemployed members to positions; help or influence in securing increased wages for underpaid members; keeping the hand of fellowship from becoming atrophied; securing the appointment of engineer members on local, county or state boards on which engineers should be members; rescuing public works from the mal-administration of politicians; discouraging the meticulous and exposing the meretricious in public engineering projects; guiding and educating the public in the formation of public policies concerning proposed works where engineering may be involved; educating county commissioners throughout the state on the desirability and the economy of employing capable engineers, and at salaries commensurate with the importance of their work; protecting members from arbitraary discharge by politial officers for whom they may be working; laying the foundation for the growth of the national societies by encouraging the worthy young engineer and the engineering student to affiliate and replenish the membership as the older members disappear; and, finally, performing those broad welfare and citizenship duties to society, the city, and the state which engineers hertofore have shamefully and too generally shirked.

We are now considering the advisability of creating a new class of member, to be called "Staff Member," to be composed of draftsmen, instrumentmen et al, who are too old to be Juniors or who are not qualified to become members of the Nationals. This provision will take care of those who follow staff engineering in the office or field of any of the members of the Associated Engineers.

In closing, let it be remembered that this association has been in existence for five and one-third years, and has steadily grown in numbers, strength and enthusiasm. Its members see no field or necessity for any other similar organization here, and thus Spokane seems to be the only city of any considerable size in the Pacific Northwest where there is no A. A. E. organization.

L. K. Armstrong, Mem. A. I. M. E., is president, and A. D. Butler, Mem. Am. Soc. C. E., is secretary.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Good Work on Assay Building

Sir—Allow me to thank you for the way you presented my article on the Assay Building. As engineers occasionally have to read the riot act to contractors, I always think that when the opportunity arises which justifies the reverse action, they should take it. In this case the general contractor, Chas. T. Wills, Inc., and the sub-contractor, the Underpinning & Foundation Co., took infinite pains, regardless of expense, to give the Government a good job. T. KENNARD THOMSON.

New York City.

Work Faithfully—Work With Faith

Sir—In the past months we have noticed various letters, appearing in the columns of *Engineering News-Record*, from gentlemen well known in the engineering profession and from others not so well known, commenting on the intrinsic recompense of the engineer, particularly the civil engineer.

In reading these letters, one cannot help but regret the condition of affairs and consider what a sad commentary they are on the morale of the profession, that some of its members have felt themselves compelled to express their chagrin on the financial results of their labors in this manner. It certainly should be food for thought for all thoughtful men, especially those employing and requiring the advice of this class of labor.

To state what the exact causes are for these conditions, and to advance a general panacea that will make everybody happy would be foolhardy; but, I do believe if the engineer would give himself a strict examination to see if he can correct a few of his own personal faults, his existence would be more satisfactory and perhaps it would help swell his pay envelope.

The engineer, I am afraid, has been looking too much at what the other fellow has been receiving. This has befogged his vision and caused anxiety to many; in the consequent state of mind they have lost their poise. It would be better to cease drawing comparisons between their conditions and that of other workmen and quietly seek out means whereby their social, economic and professional standing will be enhanced in a manner commensurate with the high dignity of the engineering profession. From the viewpoint of the mechanical engineer, I agree that the average engineer receives a meager pittance, but to continually keep comparing his average salary with that of the bricklayer, plumber, carpenter, machinist, toolmaker, or any other tradesman, that the influence of organized labor has assisted in compelling the general public to pay, will not do the fraternity any good. To many engineers, especially those who have had any dealings with organized labor, this idea of organized labor in their midst, is distasteful to say the least. If I should venture to advance a plan, it would be a scheme to legalize the profession as a whole throughout the nation, in a manner similar to the medical and legal fraternities. This would include the licensing of draftsmen and other technical workers, that hardly could be called engineers. In order to accomplish these results, however, the engineer will have to get out of his shell and take more interest in practical politics than he has heretofore done.

With regard to the undergraduate, who has decided that the engineering field holds no laurels for his brow and has decided to enter other fields of endeavor, I am led to believe that some of these letters have had a pernicious effect on the impressive minds of our youth before they have had an opportunity to judge for themselves. It also confirms an opinion that I have long held, that young men deciding on a life work requiring a special technical training, should spend at least a few months in practical work, preliminary to their course, to satisfy themselves of actual conditions and their personal aptitude for the work. I think this would avoid many disappointments and the needless waste of time and money.

For the present moment the thing for the engineer to do is to work harder and with an ever-increasing diligence, for after all, good hard productive work is really the only available remedy for our present ills. No matter what ails you, work. Work faithfully—work with faith. WALTER W. HAGERTY,

New York City. Mechanical Engineer.

Combination Wood and Asphalt Bridge Floors

Sir—In *Engineering News-Record*, Nov. 13-20, 1919, p. 866, there appears an article on a "new" type of wood and asphalt bridge flooring. I have had a very wide experience in the design and construction of this identical type of flooring, having laid the first in 1897 on a steel pony truss. Since that time I have adapted this type of floor to bridges aggregating several hundred thousand square feet.

When properly laid the floor has proved to be a success. In cases where the timbers have not been properly spiked, the weakness has resulted in cracking of the surfacing, permitting the entrance of water to the timber, and consequent decay. The ordinary precautions in the prevention of decay must be observed, that is, free circulation of air beneath and at the ends of the timbers.

I note in particular that the timber on the Chicago bridges is laid transverse to the traffic. This would account for the undue deflection mentioned, in that the load was particularly concentrated. It has been my practice to lay the timber longitudinally, forming a continuous beam the entire length of the bridge and several spans. There are several advantages in this method, among them a more favorable distribution of the load under the wide wheels of the heavier vehicles, and the reduction of the effect of impact. The elimination of vibration, as noted in the article, is an obvious result of the construction, a smooth surface and resiliency. The feature of carrying a longitudinal continuous and homogeneous beam serves to cut down the effect of impact through distribution over several panels and is more effective in absorbing shock and vibration. The reduction in impact stresses more than compensates for any increase in weight over that of the ordinary timber floor, and the floor as a solid beam adds to the component strength of the structure.

As to the size and depth of the timber, the design is somewhat problematic on account of the unknown

factor of the transverse distribution of stress. For ordinary highway bridges I have adopted the following sizes (Douglas fir) as having been proved adequate:

10 ft. between supports	2 x 8 in. and 2 x 6 in.
16 and 20 ft. between supports	2 x 10 in. and 2 x 8 in.
25 ft. between supports	2 x 12 in. and 2 x 10 in.
30 ft. between supports	2 x 14 in. and 2 x 12 in.

The timber should be so laid that there will be grooves or channels on top not less than 1 in. square. A heavier construction may be obtained through using, for example, 2 x 10-in. and 1 x 6-in., the 1 x 6-in. being a filler and not considered as adding materially to the strength.

Each run of timber is spiked to the other with not less than 40d nails (for 2-in. plank) spaced not more than 18-in. It is preferable not to spike the timber to the cross beams.

The wearing surface may be as described in any standard specifications for sheet asphalt pavement, preferably what is known as the Topeka mix, laid to a depth of 1½ or 2 in. above the timber. In certain localities, where it was difficult to obtain a proper asphaltic mix, I have used a concrete surfacing which has proved successful under heavy traffic.

A later development is the use of No. 6 or No. 8 wire or ½ in. deformed bars laid acros the timbers and stapled. These rods give the surfacing a better grip, for both concrete and asphaltic surfaces. They add considerably to the transverse strength and eliminate the formation of surface cracks in preventing the possible separation of the timbers.

There are examples of this system of flooring under service for more than 15 years and in perfect condition.

J. G. McMILLAN,
Former County Engineer, Santa Clara County.
San Jose, Cal.

A Reclamation Service Invasion

Sir—This letter is written to call attention to the recent invasion of the U. S. Reclamation Service into private irrigation investigation and construction work. Instances in point are the preliminary investigations made on the Clark Fork of the Columbia River and the Judith River in Montana during the past season. This is proposed development, not to be built with Government funds.

In construction we have many irrigation districts, of which the Yuma Mesa Auxiliary is the latest. There were construction and operation reasons why fully and partially constructed districts should be taken over by the Reclamation Service, and the increased storage afforded many private projects could have been secured in no other way. Development such as this at Yuma, however, where the area and works are not necessarily related to any legitimate Reclamation Service development, bids fair to eliminate the private irrigation engineer.

To quote from the *Reclamation Record* of September, 1919, p. 398: "If the Yuma plan proves a success it is believed that it will pave the way for the development of large tracts of irrigable land on other projects, as it provides the means of obtaining the necessary funds for building the works without going to Congress for advances." Or again from the issue of December, 1919, p. 564: "The formation of irrigation districts will enable the land owners to finance the work, especially if it is known that the construction work is to be under the supervision of the Reclamation Service."

Attention is also called to Senate Bill 3477, introduced by Senator Reed Smoot, which "authorizes the Secretary of the Interior, through the Reclamation Service, to investigate and develop projects anywhere in the United States exclusively with private funds." (*Reclamation Record*, January, 1920, p. 30, gives the text of the bill.) Whatever work of this nature is done submits the engineer in private practice to unfair competition.

This question also arises: How much of this work can be undertaken without detriment to the legitimate reclamation projects which are, for the greater part, far from completion? If the answer to this is the employment of more men by the Service, then a monopoly of the irrigation work will result and no field be left for the private engineer. Any assumption that Reclamation Service development has been more successful than that of private enterprise is open to discussion and proof.

In this proposed work it is only fair to assume that the purchasing and testing of materials will be done by the Service; and that the legal requirements of these districts will be cared for by its legal advisors. Verily, in a few short years, if a man is not of the Service, he will be nowhere. "WESTERN ENGINEER."

[To the foregoing letter A. P. Davis, director U. S. Reclamation Service, replied as follows.—EDITOR.]

Sir—The protest of "Western Engineer" is not entirely clear. Apparently he is of the opinion that the Reclamation Service has a proper field of action and his objection is limited to some recent developments. As examples he refers to three projects, the Clark's Fork, the Judith Basin, and the Yuma Mesa.

On the first two of these the Reclamation Service is doing investigational work such as it has done since its inception. Regarding the third, he says: "The area and works are not necessarily related to any legitimate Reclamation Service development." He does not state what he regards as legitimate, but the facts are that the Yuma Mesa is largely public land, so that here the United States is developing its own property; that all the irrigation water for the Mesa must be taken from the canals of the Yuma project and the power with which such water will be lifted to the Mesa will be developed by the same project, which has been under construction and operation by the Reclamation Service for many years, being one of the earliest undertaken by the Service.

Judging from the letter as a whole, I take it that what "Western Engineer" objects to is work by the Reclamation Service with private funds or on projects which it is expected will be developed by private funds. If this interpretation is correct, I think he is unduly alarmed. Though the Service has in part used private funds for many years, particularly where the United States co-operated with others in financing investigations, such work has come unsolicited and has amounted to a small portion of the total work of the Service. It is true that the experiment on the Yuma Mesa and the pending legislation referred to may enlarge such activity, but I think the fear is groundless that it will monopolize the field or injure the private engineer. The field is too broad for that, and I believe the work of the Service will stimulate private irrigation development rather than otherwise. That it has done so has frequently been stated by Western people interested in the

reclamation of arid lands, but not connected with the Reclamation Service.

The policy of the Federal Government regarding irrigation as exemplified in the work of the Reclamation Service was set by Congress in 1902 and has been little modified since.

A. P. DAVIS,
Director U. S. Reclamation Service.

Washington, D. C

Democratic Representation in Proposed Society Federation

Sir—At the conference in New York City, on Jan. 23, of the members of the councils of the national organizations of civil, electrical, mechanical and mining engineers, the idea of one big national engineering society—presumably to include "everyone of good character in the engineering profession"—was enthusiastically endorsed. A further conference has been called to meet in Chicago on April 20, at which I understand it is planned to have present official delegates representing every organization of engineers in the country.

It has been clear for some time that there should be an all-inclusive organization of engineers corresponding to the American Bar Association and the American Medical Association, which could speak and act for the profession as a whole and also give attention to the non-technical phases of the engineer's life, such as compensation, ethics, employment, and direct public service. The demand for the organization of this American association of engineers has quite naturally, I believe, come very largely from the rank and file, and especially from the younger men. Perhaps this means, primarily, a desire on the part of the less conspicuous members of the profession to safeguard their bread-winning and personal professional interests. But in a larger and deeper sense it is a recognition of the fact that the average engineer can only be what he wants to be to his city, state and nation and to his time as he associates himself with others who are like-minded. The older engineers—especially those who have been successful—do not so much require co-operation, either in securing what they want for themselves or in rendering service. That the members of the councils of the older engineering societies have voted unanimously in favor of "one big society" means that all opposition to the idea has disappeared and that we are to have it.

There is one danger, however, that if not clearly recognized may postpone the full realization of the purpose that is in the minds of the great majority of American engineers. The so-called "Report of the Joint Conference Committee," representing the Founder Societies, and dated Sept. 17, 1919, is being used as a basis for discussion. The underlying purpose of this report is irreproachable. But in some respects it affords a *very inadequate* basis for discussion. For instance, it provides for an organization of engineers to be governed by a council elected, not directly by the members, but by the boards of the federated organizations. The board of approximately 30 members which will really direct the new organization, draft its bylaws, etc., will be chosen from the membership of the council, all the members of which are elected for a four-year term.

Some picture of the kind of super-organization this provides for will be gained by imagining the American Society of Civil Engineers without annual or semi-annual meetings and governed by a council, the members of which are elected for a four-year term and *not by the members* but by the boards of local societies of civil engineers located in different parts of the country. Obviously, the electorate has little control over such an organization and such as it has operates over too long a period to be really effective.

When this report was submitted to the annual meeting of the American Society of Mechanical Engineers in December the society voted to amend it so as to "provide for an annual gathering of delegates *elected directly by the membership* of the constituent or affiliated organizations, and that the terms of office of the members of the governing body is no longer than three years."

The demand for a national organization of engineers of all kinds and persuasions is so insistent that it may be easy to launch anything that gives even surface indications of filling the bill. But the U. S. A. is committed more definitely today than ever before to both the democratic program and the democratic method. Neither can come up out of an organization of engineers superimposed from the top. The national organization of engineers which will put the profession at the forefront will be one of words and acts of which voice the will and the ambitions of the rank and file, and the officers of which can easily be held directly accountable to those they represent. To promote at Chicago an organization of the type suggested by the Joint Conference report would simply mean that some other, perhaps less "efficient," organization will occupy the field and ultimately win out because it is more in touch with the current thought and the aspirations of the profession.

MORRIS LLEWELLYN COOKE,
Philadelphia, Pa. Consulting Engineer.

[Mr. Cooke has in this letter made a very important point. We believe that all engineers will agree with him in his position. Certainly the representatives of the various engineering societies which may join the proposed federation should be elected rather than be appointed by the councils or governing bodies of the societies. This point needs to be forcefully put and insisted upon at the organizing meeting of the federation.—EDITOR.]

Pennsylvania Leads in Highway Mileage Contracted For

Reports received by the Pennsylvania State Highway Department show that Pennsylvania led the nation in 1919 in the total mileage of contracts let for road construction. To Jan. 1, 1920, Pennsylvania awarded contracts for the building of 679.26 miles of durable highways. Its nearest competitor was Illinois, which contracted for 510.70 mi. Pennsylvania's 1920 program calls for the awarding of contracts for the construction of approximately 800 mi. of durable highways. In the table figures are given for twenty-four states, which report a total of 2,795.5 mi. contracted for in 1919.

States	Miles	State	Miles
Pennsylvania	679.26	Maryland	52.40
Illinois	510.70	Minnesota	33.00
Ohio	306.68	Rhode Island	26.00
California	173.00	Kentucky	20.00
Oregon	164.00	Maine	15.00
West Virginia	153.92	Nebraska	14.50
Washington	124.80	Colorado	10.50
Kansas	119.00	New Mexico	10.00
Massachusetts	116.00	Wyoming	9.10
Missouri	114.24	Iowa	7.00
Oklahoma	86.50	District of Columbia	4.80
Delaware	73.00	Nevada	3.00

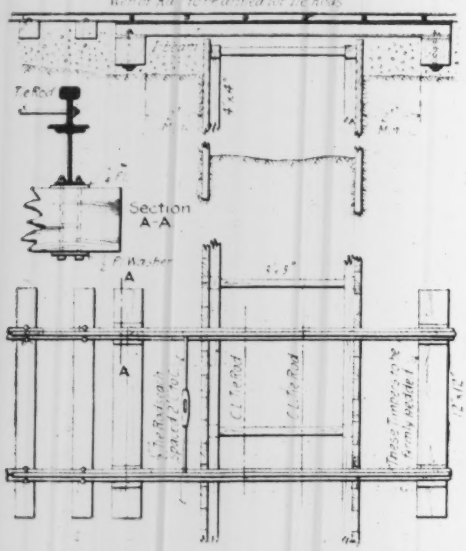
HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Method of Supporting Track Over Trench With Maximum Clearance

By John H. Sawkins
Dover, N. J.

WHILE the accompanying sketch in general does not show a new method of track support it provides maximum clearance in the trench itself, without posts or timber supports which are a part of the sup-



I-BEAM SUPPORT FOR TRACK GIVES MAXIMUM CLEARANCE FOR TRENCH CONSTRUCTION

porting scheme in the trench. This leaves the trench clear and free for a pipe line or whatever is to be constructed. The scheme suggests a maximum economy of material; i.e., two steel I-beams, two 12-in. x 12-in. timber sills, four ⅜-in. x 9-in. x 12-in. plates, eight 1-in. x 16-in. machine bolts, four ½-in. plate washers, and a few 1-in. round tierods, provided with turnbuckles. Tierods are necessary to prevent spreading of rails since they rest upon the top flanges of the I-beams.

"Nail Template" for Pavement Thickness

TO AVOID the danger of getting concrete pavement too thick or too thin the California Highway Commission has adopted what is called a nail template with which the exact elevation of the subgrade is checked for its full width just before pouring. The template is made similar to a striking-off template.

The lower side of the nail template carries a row of nails spaced 4 or 5 in. apart and projecting downward, say an inch, for the full length of the template. The nails are carefully adjusted so that when the ends of the template rest on the header boards all nail ends are just ¼ in. above the specified level of the subgrade.

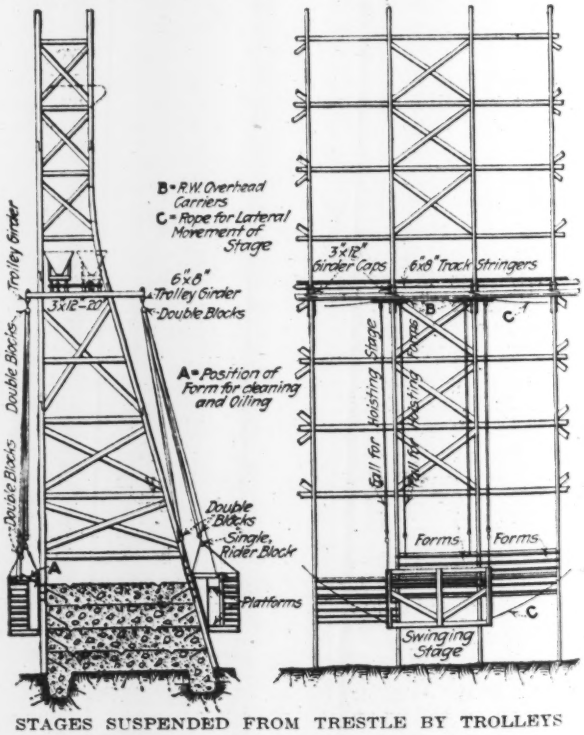
Thus, when the template is moved along the headers between concrete mixer and the end of the chute, if there are any high places in the subgrade they will be scratched, leaving marks which are readily noticed by the inspector. If the subgrade is too low the inspector notes the abnormal space below the nail points.

On state work in California the contractor is required by the specifications to lay paving not more than ¼ in. less than the prescribed thickness, and all concrete in excess of a half inch more than prescribed thickness must be paid for by the contractor. It sometimes happens that the contractor finds it cheaper to pay this excess than to correct the subgrade.

Dam Forms Shifted by Swinging Stages

TO HANDLE the forms on the Warm Springs thin-arch dam of the Malheur Irrigation District, in Oregon, swinging stages were suspended from trolleys supported by cantilevers laid over the top of a trestle, acting in a double capacity as form ribs and as industrial track support for the concrete buckets.

Two stages were provided, rigged as shown in the drawing, that on the downstream side having a slanting face to maintain the platforms horizontal. A ½-in. wire rope sling was placed around each end with a single rider block, to which a double-block and fall was attached for hoisting the stage. The trolleys carrying these falls were spaced with ¾-in. tie bars 4½ ft. on centers from the trolleys carrying the falls for hoisting the forms. Similarly the two form trolleys were spaced 9 ft. apart by a tie bar, thus connecting the train of four trolleys. The stages consisted of a frame of 2 x 10-in. timbers 5 ft 3 in. x 18 ft. in plan and 10 ft. high



STAGES SUSPENDED FROM TRESTLE BY TROLLEYS

NEWS OF THE WEEK

New York, February 26, 1920

Concrete House Conference Well Attended

Three or four hundred men and women were in attendance on each of the seven sessions of the National Conference on Concrete House Construction in Chicago, Feb. 17-19, 1920. The presence in the city at the same time of several technical meetings, among them those of the American Concrete Institute, the Building Officials' Conference, the Concrete Products Association and the Associated General Contractors of America, undoubtedly swelled the attendance at the housing conference, but besides that there were many present who were more interested in housing problems than in the technic of house construction. The program was of more interest to this class than to the engineers and contractors.

General Contractors Perfect Organization

Members Underwrite Association for $200,000—New Constitution Adopted

Subscriptions exceeding a total of $200,000 for the organization work during the next two years were secured from the membership of the Associated General Contractors of America at its annual convention in Chicago, Feb. 18-19. Subscriptions to be secured from members not present are expected to increase this sum by a material amount. With the dues it is fair assumption that during 1920 and 1921 the funds available for association work will approximate $150,000 a year.

An improved constitution, new by-laws, and a plan of development were approved, while an increased membership campaign is expected during 1920 to increase the number to more than 1,000. Starting in November, 1918, with 97 members the association now has 445 members. The attendance at the convention numbered about 200 representing about 100 firms of general contractors from 36 cities.

STANDING COMMITTE WORK

Plans for an efficiency classification of contractors and for the inauguration of a formal code of ethical practices in contracting were undertaken. Substantial progress was recorded in the development of closer relations with labor and toward securing, in writing contracts and specifications, better coordination among contractor, engineer and owner. Important legislation affecting the interests of contractors has been influenced. A far-sighted publicity plan has been formulated and put into operation.

The main subjects considered by the twelve committees which reported and the committee action on each were as follows:

Membership: The committee took action creating organization members in addition to individual members. With the prospect of 1,000 members in the near future, it is hoped that the the committee can come to the annual convention of 1921 with a list of 2,500 members.

Publicity: A monthly bulletin and a weekly news letter have been created and regular publication established.

Labor: Formal approval is given to the general plan of industrial relations proposed in Referendum No. 27 by the United States Chamber of Commerce. The research division is investigating forms of contracts and bonus and profit sharing plans. Total restriction of immigration is objected to and the re-creation of the Federal Employment Service is approved and formal action has been taken in both instances to inform Congress of the association's attitude. The committee is participating with the American Institute of Architects, the Engineering Council, and the American Federation of Labor in the plan for a National Board of Jurisdictional Awards.

Legislation: A Washington office has been established and a local manager appointed. Besides taking active part in the drafting and enactment of bills for the relief of contractors who have sustained losses on Government work

(*Concluded on page* 445)

Railroad Bill Passed by Congress on Basis of Conference Committee Report

House and Senate Adopt Measure Placing Commission in Complete Control but Providing Definite Rate Rule

The conference committee report on railroad legislation, submitted by the joint committee to Congress last week, was passed by the House of Representatives, Feb. 21, by a vote of 250 to 150, and by the Senate, Feb. 23, by a vote of 47 to 17. Although the measure is strenuously opposed by the railroad unions and there is a question of the constitutional validity of the rule for limiting "excess" earnings, it is expected that it will be approved. However, the President has referred the bill to the Department of Justice for advice as to its constitutionality.

Wages established under the Railroad Administration will continue in effect until Sept. 1 and a return to the carriers equivalent to that earned during the "test period" is guaranteed until that time, under the new measure. The principal features of the bill are as follows:

A Transportation Board is not provided and all matters of regulation, both judicial and operating, are placed in the hands of the Interstate Commerce Commission, the power of which is increased.

Rates are to be adjusted by the Commission (which is to determine the rate districts) to yield the carriers a return of 5½ per cent upon the aggregate value of the properties in each district, with an additional one-half of 1 per cent to be allowed for improvements. This to remain in effect until March 1, 1922, after which the Commission is authorized to determine and publish, from time to time, what percentage constitutes a fair return on railway property. In effect, the 5½ per cent is fixed as a minimum and the 6 per cent as a maximum return on aggregate value for the next two years, the matter being left to the discretion of the Commission thereafter.

One-half of "excess" earnings above 6 per cent must be paid into a general railroad contingent fund administered by the Commission, to be used by the Commission for the development of transportation facilities, through loans to carriers. The remaining half of the "excess" is to be placed in a reserve fund of the carrier until such fund equals 5 per cent of the value of the carrier's property and thereafter may be used for any other lawful purpose.

Permissive consolidation of existing systems is provided for in accordance with a general consolidation plan to be prepared by the Commission. The compulsory feature of the Senate bill is dropped.

Appropriation of $500,000,000 is made, to be used as a revolving fund from which to make loans to carriers and pay claims growing out of Federal control.

Regarding the labor question, it is provided that all carriers and railroad employees exert "every reasonable effort" and adopt "every available means" to avoid interruption of service through disputes over wages or working conditions. Although compul-

(*Concluded on page* 445)

Oppose "Comprehensive Organization" of Engineers

Group in Am. Soc. C. E. Urges Defeat of One of Main Proposals of Development Committee

Asserting that "there is a movement to cut the society entirely adrift from its traditions and to carry it abruptly into untried fields," a statement dated Feb. 14, headed "A Word of Caution," and signed by 106 members has been sent out to the membership of the American Society of Civil Engineers. The statement urges the defeat of the proposal, submitted as part of the recent questionnaire based on the Development Committee report, to create a "comprehensive organization" for the conduct of civic and welfare work. The statement is published below in full:

A word of caution: To the membership of the American Society of Civil Engineers (relative to questionnaire authorized by annual meeting).

Some of the steps which this Society is now asked to take are highly questionable, if not dangerous.

The American Society of Civil Engineers was organized as and has never pretended to be anything else than a professional society. Its constitution provides that "Its object shall be the advancement of engineering knowledge and practice and the maintenance of a high professional standard among its members."

For fifty years its *Transactions* have contained papers that best reflect progress in engineering in America. It has done more to advance the science and art of engineering and to establish the prestige of the profession in America than any other agency.

There is a movement to cut the Society entirely adrift from its traditions and to carry it abruptly into untried fields. Our organization is constituted as a professional society. Its work as such is of pre-eminent importance. Our Society should do professional welfare work in any manner proper and practical, but should not commit itself as a body, financially or otherwise, to such an organization as proposed in Question 3.

A strong management of this Society is essential. If the present management is not sufficiently representative, and if the machinery for electing officers is not satisfactory, let us improve it promptly. Let us progress with other internal betterments just as rapidly as the vote of the membership indicates its intent.

This Society cannot stand still. It must go forward or backward. Let us drive it forward constructively and with reasonable deliberation.

In adjusting to new conditions let us maintain the high standards of the Society and equally strive to increase its usefulness. Let us not forget the great good that has been accomplished in the past. Let us reflect upon the Society's high ideals and its high standards, and remember that it has drawn to its membership nearly all civil engineers of adequate qualifications in this country and that applications are now and have recently been coming in more rapidly than ever before.

Question 3 proposes the formation of a new and untried organization reported by the Joint Conference Committee. Its use of funds of this Society, confessedly inadequate for enlarging our own professional activities as recommended by the Committee on Development, would weaken this Society. And yet on the basis reported the funds of the proposed new organization would be insufficient to produce adequate results.

It is impossible in our opinion to effect solidarity of the profession as a whole by proceeding as proposed in Question 3.

We recommend strongly that Question 3 receive a "No" vote.

Question 3 reads as follows:

"*Shall the Society for the purposes set forth in Questions 1 and 2 actively co-operate in the creation of the comprehensive organization as outlined in the Joint Conference Committee Report?* (Report, Division C, pp. 10-19)."

John W. Alvord
C. I. Anderson
W. G. Arn
Bion J. Arnold
A. S. Baldwin
Onward Bates
R. E. Belknap
J. A. Bensel
W. L. Breckenridge
H. Eltinge Breed
Paul G. Brown
D. J. Brumley
R. S. Buck
Ralph Budd
Walter Buehler
C. B. Burdick
Wm. H. Burr
H. J. Burt
F. W. Cappelen
W. T. Chevalier
George C. Clarke
T. L. Condron
J. A. Connelly
A. S. Crane
C. R. Dart
J. V. Davies
Geo. S. Davison
F. W. Dencer
S. L. F. Deyo
J. M. Farrin
H. B. Fleming
R. P. H. Ford
Geo. W. Fuller
W. E. Fuller
W. D. Gerber
George Gibbs
A. L. Golinkin
Paul E. Green
T. L. D. Hadwen
Wm. H. Hall
A. J. Hammond
R. J. Harding
J. N. Hatch
Allen Hazen
Eugene H. Heald
E. R. Hill
F. W. Hodgdon
John P. Hogan
C. M. Holland
Wm. Hood
E. T. Howson
L. R. Howson
C. R. Hulsart
A. C. Humphreys
F. R. Judd
W. V. Judson
C. H. Keefer
Frank M. Kerr
Geo. W. Kittredge
G. C. D. Lenth
Nelson P. Lewis
Chas. F. Loweth
Geo. L. Lucas
J. R. McClintock
Chas. Macdonald
D. H. Maxwell
D. E. McComb
J. C. Meem
L. J. Mensch
Thaddeus Merriman
R. Modjeski
R. Montfort
E. L. Mosley
C. H. Mottier
M. M. Murtaugh
A. W. Newton
F. C. Noble
Wm. Barclay Parsons
W. C. Pauli
W. H. Penfield
T. F. Quilty
Isham Randolph
R. I. Randolph
A. F. Reichmann
Robert Ridgway
C. H. Rust
H. R. Safford
James F. Sanborn
M. R. Sherrerd
S. T. Smetters
J. Waldo Smith
J. P. Snow
R. E. Spear
I. F. Stern
T. H. Strate
Chas. L. Strobel
R. H. Thomson
James L. Tighe
F. G. Vent
B. H. Wait
John F. Wallace
S. Whinery
W. J. Wilgus
C. B. Wing
Frank E. Winsor
A. W. Woodman

Camp Meade Builders Banquet

The Pittsburgh engineers who engaged in supervision of construction of Camp Meade, Md., held a victory banquet in Pittsburgh, Feb. 17. Leo Hudson, consulting engineer, was toastmaster and the principal addresses were delivered by Morris Knowles, supervising engineer of Camp Meade, and J. D. Stevenson, city bridge engineer.

Engineers Discuss Traffic and Type of Vehicle Tunnel

Public hearings were held at the Engineering Society's Building in New York City by the Interstate Bridge and Tunnel Commission of New Jersey and New York on Feb. 21 and 23 to gather opinions on the traffic and construction phases of the vehicle tunnel design recently recommended by the commission's chief engineer, and reported at length in last week's issue. The sessions were attended largely by engineers. Their general effect was to indicate almost unanimous approval of the traffic provisions made in the design, but in the matter of type and method of construction to show a considerable demand for securing comparisons of economy between the recommended design and several other tunnel types.

Statistics Were Presented

In the hearing of Feb. 21, devoted to traffic, traffic-count statistics were presented by F. S. Greene, Commissioner of Highways for New York, and by W. G. Clark, of the New Jersey Highway Commission, for that state. Increases in volume of vehicle traffic ranging from 300 per cent to 2,000 per cent in ten years (1909-1919) were reported, and the present overshadowing importance of motor vehicles was strikingly brought out. John F. O'Rourke questioned the computations of expected traffic through the tunnel, but George F. Pride and others, speaking for team and truck operators who now have daily experience with ferry conditions, predicted that no matter what traffic estimate be adopted, the inauguration of the tunnel will show the estimate to be exceeded three to ten times. Mr. Pride also asserted that the through traffic which the tunnel is expected to serve will not get a chance to use it, as railroad and warehouse freighting between New York and Jersey City will absorb its whole capacity and leave a surplus. W. G. Clark and T. J. Wasser, Hudson County Engineer, urged the importance of western approaches, *i.e.*, means for crossing the Bergen Hill, and mentioned the Newark Bay bridge, to connect Bayonne with the state highway system south of Newark, as an important approach line which will facilitate traffic to the west by passing it around Newark. Amos Schaeffer reported traffic-density figures on Manhattan streets, with a maximum of 0.97 vehicle per foot width per minute on the Park Ave. viaduct, and on the basis of these figures suggested restudy of the Manhattan approach to separate the two lines of traffic. R. C. Falconer, chief engineer of the Erie R.R., also urged this separation.

On width and height, the design figures of 20 ft. and 13 ft. 6 in. were approved, except that F. S. Greene suggested reducing the width between curbs to 18 ft., a suggestion that was strongly opposed by others. Wheel channels in the pavement and a bar-

rier curb along the center line were proposed by several as essential aids in guiding vehicles and reducing the chance of accident.

At a second hearing on Feb. 23, on design and construction method, John F. O'Rourke spoke in advocacy of a 44-ft. single-tube shield-driven tunnel lined with 4-ft. concrete blocks, substantially as recommended by General Goethals as consulting engineer to the commission two years ago. He also offered plans for concrete-block tunnels to fit other capacities and roadway arrangements. T. K. Thomson advocated a tunnel to be built by the trench method, for safety and economy. J. C. Meem proposed three alternative construction methods. Lazarus White, St. John Clarke and others urged that the commission ask alternate bids on designs other than that recommended by the chief engineer.

Gen. Geo. W. Goethals asserted that while the recommended design is good, the tunnel can be put through at much less cost. Supporting his earlier recommendation for a large tunnel with concrete block lining, he stated that analysis by M. A. Howe's method, on the basis of hydrostatic pressure with material weighing 100 lb. per cu.ft., showed the line of pressure to be within the middle third of the shell throughout, and the greatest stress to be less than the compressive stress set up by the shield jacks. Paul G. Brown, in endorsing the recommended design and method, stated that the engineering board of the state reconstruction commission some time last year found no engineer with experience in Hudson River tunneling who considered a concrete block tunnel, or a 42-ft. tunnel, practicable in the Hudson silt.

Clay Under Hudson

In supporting the plan for a large-size tunnel with concrete-block lining, Mr. O'Rourke massed much evidence to show that Hudson silt is a firm clay which stands well when not demoralized. Parts of the old brick sections of the Haskin tunnel opposite Morton St., built in the '70s, are still in existence, at places with part of the ring cut away. Deforming pressures of the material are developed in ordinary shield work by the presence of water around shield and lining, he said, and this shell of water is eliminated if the void back of the shield tail is packed with gravel by the gravel-shooting method used by him in East River tunneling. Progress of 22½ ft. per day was made at Detroit regularly with concrete-block lining, he stated. Mr. O'Rourke argued for placing the tunnel at depth of 50 ft. instead of 60 ft. as recommended by the engineer, to reduce approach length. G. B. Snyder, supporting the recommended design, suggested that built steel segments might be found superior to cast iron for the lining. T. K. Thomson said that while it cannot be proved that a shield tunnel in the Hudson River will not last a thousand years, neither can it be proved that it will last as many minutes. As safest, best and cheapest he advocated a tunnel built by the trench method, and he requested opportunity to submit a bid in competition with the engineer's design.

St. John Clarke protested against the attempt to settle engineering questions in a public hearing, and proposed that discussion be deferred until bids are available. F. D. Leffingwell criticized the differential-pressure shield proposed for the 44-ft. tunnel, as being dangerous or impracticable in the coarse, soft-ground formations in the shore sections of the tunnel and probably unnecessary in the silt of the middle section.

Hoover Becomes Head of Mining and Metallurgical Engineers

At the annual meeting of the American Institute of Mining and Metallurgical Engineers, held in the Engineering Societies Building, New York City, Feb. 16 and 17, Herbert C. Hoover was inaugurated as the Institute's president for 1920. In his address, reproduced in part on another page, Mr. Hoover discussed the nation's industry, economics and politics.

More Water for Topeka

Two engineering firms and two engineers have been selected to investigate and report on the water supply problem of Topeka, Kan., as follows: Prof. W. C. Hoad, Ann Arbor, Mich.; Burns & McDonnell, Kansas City, Mo.; Black & Veatch, Kansas City, Mo.; and C. A. Haskins, Lawrence, Kan. The present supply from wells along the Kansas River is inadequate. The investigation will consider the advisability of extending the well system or of using a purified supply from the Kansas River or a combination of the two.

Atlanta City-Planning Board

A city-planning board of 25 members has been appointed at Atlanta, Ga., with John W. Grant as chairman, and Kendall Weisiger of the Southern Bell Telephone Co., as secretary. Tentative plans have been made for ten standing committees, including one on topography and hydrography, one on statistics, one on housing and public welfare, one on transportation and building control.

Engineering Extension Courses At University of California

The University of California Extension Division has added three night classes in engineering subjects to its extension courses. The new courses, in which the first class met Feb. 24, are in applied mechanics, in reinforced concrete, and a more advanced course in reinforced concrete. William S. Sullivan is instructor in the added courses.

American Concrete Institute Has Live Meeting

Emphasis Laid on Reports of Committees Standardizing Specifications And Perfecting Practice

For the first time in three years the American Concrete Institute returned this year to its regular practice of meeting in February. Taking advantage of the probable presence in Chicago of a number of attendants on the concrete housing conference, the convention was held in that city on Feb. 16 to 18. Whether due to the numerous collateral societies meeting at that time or not, the sessions were unusually well attended, comparing quite favorably in that respect to the old days when the cement show brought a number of visitors who would not otherwise have come. The tone of the meetings, too, was indicative of the awakened spirit in the institute and gave promise of a successful year ahead.

Special effort was made this year to emphasize the committee work. In consequence eighteen committees reported and time was left for only seven papers. The program in no wise suffered, however, because many of the reports had the controversial nature which provoked discussion. In addition to the regular standing committees, five special committees on live details of concrete practice, which had been appointed in the past six months, brought in reports promising valuable information on matters still far from being settled.

Five Standards to Ballot

Five standards were adopted by the convention to be sent to letter ballot for adoption. These were: Recommended Practice for Portland Cement Stucco; Nomenclature Standards; Building Regulations for Concrete; Unit Values for Vertical Shear; and Specifications for Concrete Sewers. The recommended stucco practice is practically in the form in which it was submitted at the last convention, except that as presented it contains, in parallel columns, the specifications clauses and the comments thereon. As has been stated before in these columns, it is the best information available on how to produce stucco. Standard building regulations have been before the institute in some form for three years and have been revised from time to time by the committee. This year the changes mainly comprise the use of the provisions for shear proposed by the special committee on that subject. These provisions were also adopted by the convention for letter ballot; and the report of the committee was accepted for publication. Objections to the shear recommendations were submitted in writing by C. A. P. Turner and Edward Godfrey, the former attempting to show by mathematical analysis that the shear values assumed were not consistent

and, in some cases, not large enough; the latter presented again his well-known objections to the stirrup as a shear member, though voicing approval of the unproved anchorage requirements.

The sewer specifications have also been before the institute for some years, but have never been approved, mainly because of references to the contractor and contract requirements. This year the committee removed these clauses, to the satisfaction of the convention. The standard specifications for roads and pavements, now in force three years, have been revised in minor respects by the committee, but because the changes had not been submitted to the members the requisite thirty days they had to go over for another year.

Committees Report Progress

Progress only was reported by the remaining standing committees. That on Concrete Aggregates indicated that it was conducting in a number of laboratories co-ordinate tests of various concrete proportioning theories proposed in the past two years, and reported that it favors the adoption of a new method of the determination of the unit weight of aggregate desired by C. M. Chapman. Specifications for its manipulation are to be presented next year. The committee on Sidewalks and Floors has been studying the matter of floor wear, and while not prepared to present recommendations is accumulating records of service and tests which it is hoped will prove valuable soon. They have found, for instance, that proper provisions for keeping the floor wet after laying will increase strength and wear protection at least 40 per cent.

The Committee on Fireproofing continued to devote its attention to the results of the tests. On fire resistance of concrete columns made at the Bureau of Standards by Walter A. Hull, who presented the latest results of these tests in a paper at the meeting. The most recent deduction from these tests, as reported by the committee, is that limestone aggregate is a decidedly superior ingredient of fire-resisting concrete and that siliceous aggregate, while still subject to spalling under fire, can be used if the protective coating of concrete made from it be reinforced with mesh.

A subcommittee on Tests of Reinforced Concrete Floors submitted a tentative report giving recommended practice in testing floors of reinforced-concrete buildings and the Committee on Concrete Storage Tanks a tentative recommendation governing the construction of concrete oil tanks. The Committee on Reinforced-Concrete Barges and Ships presented a résumé of the present status of knowledge on this subject, an abstract of which will appear in an early issue of this journal.

Of the five special committees four had very live reports. That on floor finish was not able to get its material together in time for the convention. The report on shear has already been noted. The remaining three were on contractor's plant, standardization of steel bars for reinforcement, and standardization of units of design.

The contractor's plant committee limited itself to a study of the plant required on a concrete building, feeling that for the present, at least, the more massive forms of construction were out of its field. It analyzes, in its report, the various factors which govern plant selection and gives in detail the governing considerations and final results in plant on one recent large building job. The report is merely preliminary of the real work of the committee, but indicates a most valuable addition to contractors' knowledge. The committee standardizing design units calls attention to the great economic loss now common in the undue use of many standards of detail in concrete construction. It recommends the establishment of a certain limited number of sizes of members and units, the use of which may require somewhat more material owing to the inability of the designer to meet so closely the requirements of stress, but which will save in the long run an account of the saving of forms and labor. The committee proposes next year to prepare some of these standards for submission to the Institute.

Somewhat akin to this intention is the work of the special committee on steel bar specifications. This committee states that the bar manufacturers have agreed to roll reinforcement only from the intermediate grade steel of the manufacturers' standards and only in certain fixed sizes (noted in the item on p. 430 of this issue). This stand has been taken in order to speed up bar rolling, which is falling behind the demand, so much so that there is a growing bar shortage and inability to fill orders. The committee recommended that the Institute approve this action. This was done in so far as the sizes are concerned, but the convention voted to amend the report so as to recommend to engineers to allow all possible leeway in steel specifications, provided the steel satisfied one of the A. S. T. M. specifications for reinforcement bars. In other words, the engineer is urged, in the interests of facilitating manufacture, not to insist on a soft, intermediate or hard grade, if one of the other grades is available.

In a paper entitled "Compressive Strength of Concrete in Flexure," W. M. Slater and R. R. Zipprodt advanced a plea for a different method of determining safe unit compression stresses in concrete beams. They pointed out that the straight-line formula for computing gives stresses below those which actually exist. Further, they show by tests that actual compression failure in beams, by the parabolic formula, is higher than compression failure of cylinders of the same concrete. By the present practice, safety in compression is judged by the relation of the straight-line compression of the beam to the actual breaking stress assumed in a cylinder of concrete of the same mix as the beam. The authors show that in certain tests it would have been safer to take 45 per cent of the actual breaking strength of cylinders than the 32½ per cent of the assumed strength of the concrete allowed by the Joint Committee. They suggest that with improved methods of manufacture and inspection, so that concrete strengths can be closely predicted, the assumption for safe compressive unit stress of 45 per cent of actual cylinder failure would be a proper provision.

Other papers which will permit of more extended abstract at a future time were those by Stanton Walker on "Examples of Application of Abrams' Water Ratio to Proportioning Concrete," by R. B. Crepps on "Wear and Strength Tests of Concrete," and by E. B. Smith on "The Pressure of Concrete Against Forms."

The Wason medal, for the most meritorious paper in the 1919 *Proceedings*, was awarded to W. A. Slater, of the Bureau of Standards, for his paper on "Structural Laboratory Investigations in Reinforced Concrete Made for the Concrete Ship Section, E. F. C."

The meeting was presided over by President W. K. Hatt, of Purdue University, who finished his third year in that position. He is succeeded by H. C Turner, of the Turner Construction Co., of New York. The Institute is in fair financial condition, but is planning an intensive campaign for new members and at the same time will extend its activities so as to make a more steady appeal to its members. The secretary is Harvey Whipple, New Telegraph Building, Detroit, Mich.

Program of Foreign Trade Convention Is Announced

The program for a comprehensive discussion of elements in the country's foreign trade problems at the seventh annual foreign trade-convention in San Francisco, May 12-15, was announced Feb. 23 by James A. Farrell, chairman of the National Foreign Trade Council. The main division of subjects for discussion is: Fundamentals of our foreign trade; foreign trade policies; imports and exports, and a national program for foreign trade.

Armour Institute Given $6,000,000

An additional gift of $6,000,000 to Armour Institute, Chicago, was made Feb. 21 by J. Ogden Armour. The institute has outgrown its present facilities, and the gift includes a new site of 80 acres which cost $1,000,000. The remainder of the six millions will be expended in the construction of new buildings. It is understood that the new location will make possible the introduction of additional engineering courses into the institute's curriculum.

Railroad Bill Passed by Congress on Basis of Conference Committee Report

(*Concluded from page* 441)

sory arbitration is not provided, it is the plan that decisions of a board of nine members appointed by the President, equally divided between employees, employers and the public, will be made binding through publicity of negotiations. However, it is provided that disputes shall be decided, if possible, by the railway boards of labor adjustment established by agreement between the carriers and their employees.

Determination of "value" for rate-making purposes is left to the Commission with the command that it shall give the property investment of the railroads only that consideration to which it is entitled under the law in establishing value for rate-making purposes.

The membership of the Commission is increased from nine to eleven members, with an increase of $10,000 to $12,000 in annual salary. The Commission's increased powers include: Establishment of minimum as well as maximum rates, supervision of car service in emergency, compulsory joint use of terminals, priorities and embargoes, approval of securities issues and new construction or abandonment of existing lines.

Complete control over railroad operations throughout the country in "case of war or threatened war" would be centered in the Commission which would have powers similar to those now exercised by the Railroad Administration.

Bids for Water-Works Improvements Wanted by Akron, Ohio

Bids for carrying on the extensive program of water-works improvements at Akron, Ohio, outlined in *Engineering News-Record*, Sept. 25. 1919, p. 608, are to be received March 5 and further contracts will be let a few weeks later. The principal items open to bids on March 5 are 3,300 tons of 4- to 20-in. cast-iron pipe and specials, 500 6- to 8-in. hydrants, 400 6- to 16-in. valves, a 500,000-gal. steel tank on a 70-ft. tower, and 30,000 cu.yd. of grading. Later in March or else in April bids will be asked for laying 32 mi. of 6- to 20-in. pipe, in six contracts of 3 to 8 miles each; a 20,000,000-gal. addition to the mechanical filter plant, in ten units; and a 3,000,000-gal. coagulating basin of either groined arch or flat slab design. The additions to the treatment works will require 23,000 cu.yd. of excavation, 5,000 cu.yd. of concrete and an 80 x 140-ft. one-story brick building. G. G. Dixon is chief engineer of the Bureau of Water-Works improvements and H. L. Newhall is principal assistant engineer. H. H. Frost is superintendent of water-works, and E. A. Zeisloft is director of public service.

Canadian Contractors and Material Dealers Organize

Formal organization of the Association of Canadian Building and Construction Industries, composed of general contractors, sub-contractors and material dealers, was recently effected at Montreal, Que. The following officers were elected by the eighty-six members present from all parts of the Dominion: President, J. P. Anglin, Anglin, Norcross, Ltd., Montreal; first vice-president, J. B. Carswell, Carswell Construction Co., Toronto; second vice-president, James Mackie, James Mackie Co., Ltd., Winnipeg; secretary, James Rhinnemore, painting contractor, Toronto; and treasurer, G. A. Cram, general contractor, Ottawa.

In connection with the conferences resulting from the formal organization of the association general contractors in attendance voted to incorporate as the Canadian General Contractors' Association. J. B. Carswell, Toronto, was elected president; W. H. Yates, Hamilton, vice-president; and Hugh Graham, Ottawa, secretary.

U.S. D.P.W. Support Urged in Engineering Mass Meeting

In response to a general call, members of the national engineering societies resident in New York City met in the auditorium of the Engineering Societies Building Feb. 19, to hear a plea for co-operation in promoting the establishment of a national public works department. M. O. Leighton, chairman of the National Public Works Department Association, was the principal speaker.

Ridgway Heads Newly Organized N. Y. Section, Am. Soc. C. E.

At a meeting Feb. 18 in the Engineering Societies Building a New York Section of the American Society of Civil Engineers was organized. Robert Ridgway was elected president, and May was chosen as the month of the annual meeting. Such an organization is in line with a policy approved at the recent annual meeting of the parent society—that it be divided into sections to embrace all members.

There were twenty New York City members of the American Society of Civil Engineers present at the meeting. J. Waldo Smith and Clifford M. Holland were chosen temporary president and secretary, respectively. The object of the meeting was explained and successive resolutions were passed declaring the section formed, adopting the form of constitution approved by the national society's Board of Direction Jan. 20, 1920, and authorizing a general call to members resident in District No. 1 of the national society to join the local section.

A nominating committee consisting of Walter E. Spear, Arthur S. Tuttle and George L. Lucas was appointed at the beginning of the meeting. After deliberation its report was presented and the following officers were elected to serve until the annual meeting in May: President, Robert Ridgway; first vice-president, J. Waldo Smith; second vice-president, Allen Hazen; secretary, Lewis D. Rights; treasurer, Frederick C. Noble; directors, Otis E. Hovey and R. S. Buck.

A motion of S. N. Castle was passed authorizing the president to appoint representatives to participate in a joint conference of representatives of other local sections of national engineering and technical societies and of local engineering societies The number of such representatives of the New York Section was fixed at three by a vote on a motion made by Mr. Hovey. Others in attendance who addressed the meeting were Daniel Bontecou, Arthur S. Tuttle, Herbert C. Keith, and Charles Hansel.

Case Against Chimney Constructors Disposed Of

Fines aggregating $18,250 were recently imposed in the Federal court for the Southern district of New York upon five chimney construction companies and 15 individuals connected with these concerns for violation of the Sherman anti-trust law. Not all of the defendants were fined. All had entered pleas of *nolo contendere*. As noted in the news columns of *Engineering News-Record* of Jan. 1, 1920, p. 59, a Federal grand jury indicted the Alphons Custodis Chimney Construction Co., the M. W. Kellogg Co., H. G. K. Heinicke, Inc., Bergen Lindeman, Inc., and the Heine Chimney Co., together with 15 individuals, on the charge of having organized and operated a trust for the construction of radial brick chimneys.

General Contractors Perfect Organization

(*Concluded from page* 441)

personal representation has been made of the association's attitude on the legislation for a department of public works, on the disposition of the railways, on daylight saving, on income taxation and on Federal home loan banks and on a score of other acts affecting the construction industry.

Ethics: Careful study has been made of the codes of ethics of various professions and a statement has been drafted to serve as a basis for a code of ethical practices in contracting.

Methods: Payments for estimates and quantity surveys are being taken up with architects and engineers to determine an equitable and workable plan. Rental rates for equipment are being investigated. An extended analysis of construction methods is in progress.

Contracts: Contract provisions are being studied with the view of developing a standard form of contract. The Research Division has gathered 113

contracts of various firms—unit-price, lump-sum, cost-plus-percentage, cost-plus-fixed-fee, etc.—with comments on each form by engineers and contractors who are using them and this information will be used as a basis for a standard form to be developed.

Construction Development: Grouping of members into divisions is recommended for efficient action. Three divisions have been created: (1) Highway contractors, (2) Railway and public works contractors, (3) Building contractors.

Codes: The licensing of contractors has received attention. Closely related to this question is the registration and classification of all contractors, particularly those engaged on public work. The thought is that some definite plan of registering contractors according to their organization, equipment, past performance and financial responsibility should be drawn up for adoption by public works officials to eliminate irresponsible contractors.

Membership and Dues

Dues are arranged on a sliding scale based on the volume of business. This scale is as follows:

Class	In Excess of	Less Than	Yearly Dues
A	$3,000,000	.....	$500
B	2,000,000	$3,000,000	250
C	1,000,000	2,000,000	150
D	500,000	1,000,000	100
E	250,000	500,000	50
F	.....	250,000	25

These are dues for individual members. The dues of Associated Organizations shall be 20 per cent of their annual income from dues with a minimum payment of $25 and a maximum payment of $100 for each one of their individual, firm or corporation members.

Prices, Production and Construction

That little hope for lower prices or greater production or increased construction is offered by an analysis of present economic conditions was the conclusion of Prof. Herald H. Moulton whose address opened the session devoted to construction, contracts and industrial relations. The best conclusion to be based on available figures, was that measured in units of work accomplished—there was less construction in 1919 than in either 1914, 1915 or 1916. The vital factors limiting work were labor shortage, car shortage and lack of money. Immigration could not help the labor situation in 1920 or perhaps for some years, since with the reduced value of foreign money the sum required by our immigration laws for admission of immigrants had been multiplied from two to five fold. The shortening of the working day and the decrease in efficiency made some 2,500,000 to 4,000,000 more workers necessary to produce the same amount as previously. The car shortage would persist because few cars had been built and owing to the shorter working day and decreased efficiency cars were held a longer time out of service waiting for repairs. Finally our money reserve was approaching the point where money for construction could not be secured at reasonable rates. Professor Moulton considered that we might expect wages to advance, freight rates to increase and prices to increase.

Highway Contracting Problems

The outstanding problem in highway contracting, according to A. R. Hirst, state highway engineer of Wisconsin, was the problem of improving contractors' methods and practices. Most contractors, he said, were not conducting their business nor keeping their records in such a manner that they were improving their service from one year to another. Through lack of co-operation and reluctance to disclose their costs the inefficiency of one year was being repeated the next year and highway construction was becoming a record of mistakes repeated indefinitely. Contractors, according to Mr. Hirst, were not meeting the situation by improving their practices but were asking that they be granted relief through higher and still higher prices, through less rigid specifications and through risk relieving forms of contracts. He called upon contractors to analyze and study costs and outputs with a view of improving their service and proving their claim to be experts in construction. Otherwise state highway officials would be fully warranted in taking the task of building highways away from contractors and into their own hands.

A national transportation system under government regulation was suggested in a lengthy paper by Richard Waterman, secretary of the railway committee of the Chamber of Commerce of the United States. He proposed a co-operation of six units: Railways, interurban lines, street railways, highways, waterways and aviation, all under control of the Interstate Commerce Commission. As to the proposed railway bill, he approved of permitting—but not compelling—consolidation of railways to form a few large systems. He thought the wage question is properly omitted, since it should be dealt with in a separate general labor law.

Election of Officers

Count of the letter ballots showed the following officers elected: President, W. A. Rogers; first vice-president, T. T. Flagler; second vice-president, J. W. Cowper; third vice-president, W. O. Winston; advisory board, N. F. Hoggson, F. L. Cranford, F. J. MacIsaac.

Cincinnati and Washington Census Figures First Out

The first figures from the 1920 population count were announced by the Bureau of the Census Feb. 21. Washington, or strictly the District of Columbia, has 437,414 inhabitants (as of Jan. 1), which is an increase of 106,345 or 32.1 per cent over 1910. The corresponding figures for Cincinnati are 401,158, 37,567 and 10.3 per cent. The 1910 census was as of April 15.

Concrete Joint Committee Organizes

Representatives of the Five Societies Get Together for First Meeting and Plan Work

On the invitation of the American Society for Testing Materials, the four other societies which contributed to the Joint Committee on Concrete and Reinforced Concrete have again appointed each five members, who with the five members appointed by the A. S. T. M., will constitute a new Joint Committee to prepare rules and regulations for the design and construction of concrete and reinforced concrete. The members have met and effected an organization with Richard L. Humphrey as chairman, J. J. Yates as vice-chairman and Duff A. Abrams as secretary. They have further subdivided the work into the following committees: Materials (other than reinforcing); metal reinforcing; proportioning and mixing; forms and placing (including under water); design; details of construction (including fire-proofing); waterproofing and protective treatment; and surface finish. These committees will proceed immediately to formulate reports to the full committee for next June.

The personnel of the Joint Committee is as follows: *American Society for Testing Materials:* Richard L. Humphrey, chairman, Henry H. Quimby, L. S. Moisseiff, A. T. Goldbeck, E. E. Hughes; *American Society of Civil Engineers:* Rudolph P. Miller, chairman, W. K. Hatt, A. E. Lindau, W. A. Slater, Sanford E. Thompson; *American Railway Engineering Association:* J. J. Yates, chairman, G. E. Boyd, F. E. Schall, C. C. Westfall, H. T. Welty; *American Concrete Institute:* S. C. Hollister, chairman, R. W. Lesley, A. R. Lord, E. J. Moore, L. C. Wason; *Portland Cement Association:* F. W. Kelley, chairman, Ernest Ashton, J. H. Libberton, E. D. Boyer, D. A. Abrams.

Pittsburgh Transit Commissioner Removed by Mayor

E. K. Morse, transit commissioner of Pittsburgh, has been removed by Mayor E. V. Babcock. It is generally assumed that the reason for the action was Mr. Morse's opposition to the street-car loop subway project originated by the mayor, for which project a bond-issue of six millions was voted by the people last summer. Following the removal, the city council held a hearing at which Mr. Morse presented his views on rapid transit. He asserted that the loop subway would not help to solve the city's transportation difficulties or needs, that the downtown congestion is not due to street cars as these constitute only one-fifth of the traffic, and that the loop is not able to carry more than half the street cars entering the business district. In view of these facts he urged that the bond issue be applied to true rapid-transit construction.

Iowa Engineers Combine Locals With State Society

Greatly extended society activities were provided for at the thirty-second annual meeting of the Iowa Engineering Society which met Feb. 17, 18 and 19 in Fort Dodge. Without much discussion a plan of reorganization was approved whereby all of the local clubs and local sections of national organizations are to be consolidated with the state society as a central body, the locals becoming centers of districts to be formed after a study of the distribution of the engineering population of the state. A central governing council made up of delegates from the locals would decide the policy of the state society in regard to publicity, legislation and any other improvement of engineering as a profession. A percentage of the dues will go to the state society. This scheme of organization has already been ratified in principle by local clubs in Des Moines, Waterloo, Davenport, Sioux City and Boone. New clubs in Ames and Cedar Rapids have been formed to go into the consolidation. The chapters of the American Association of Engineers at Davenport and Ames were asked to join in with the other locals. The plan has been fostered and practically carried through by the Iowa Association of Members of the American Society of Civil Engineers. An organization meeting of delegates of practically all of these bodies was held Feb. 20 to formulate a definite constitution upon which the societies might base the necessary changes in their respective constitutions.

Aside from the technical program, which was principally devoted to drainage, highways and pavements, there were vigorous discussions on costs, professional practice, the workings of the recently enacted registration law and engineering publicity.

A committee on professional practice, with T. R. Warriner as chairman, has investigated the salaries of engineers in colleges, state, county and municipal offices. The increases over 1915 ranged from 5 to 57.5 per cent, usually the advance being largest in the lower paid grades. The committee stated that the salaries were too low in 1915 and that they should now be increased 50 per cent above what they should have been in 1915. No plan was outlined as to how the advance might be obtained. As to fees and commissions for consultants the committee felt that the standards adopted by the society in 1918 were too low and should be increased by 50 per cent, also that no per diem fee under $35 should be accepted.

The society has had a large increase in membership, 73 being added, bringing the total to 324. J. H. Dunlap, secretary, attributed it largely to the registration law. The officers elected for the succeeding year are as follows: President H. H. Dean; vice-president, Clark Streetor; directors, J. G. Thorne and K. L. Patzig.

Wisconsin Engineers Meet

State highways, inspection of contract work and the proposed national department of public works were the prominent subjects at the twelfth annual meeting of the Engineering Society of Wisconsin, held at the University of Wisconsin, at Madison, on Feb. 20 and 21. As to the state highways, James Gillespie stated that present difficulties are not those of funds but of labor, material and transportation. For the 1920 program there is $18,000,000 available and it is planned to build about 400 miles of concrete road, 700 miles of gravel road and 600 miles of unsurfaced road. No bituminous macadam is included as it is considered best to step direct from gravel to concrete as traffic develops.

How to prepare engineers' reports to financiers and investors was an interesting topic included by Mr. Mead in an address on the general subject of land reclamation and development by drainage.

Knowles and Pratt Engineering Organizations Combined

Announcement of an amalgamation of the organization of the late R. Winthrop Pratt of Cleveland, Ohio, and that of Morris Knowles, Inc., of Pittsburgh, was made at the seventh annual dinner of 80 officers and employees of the latter firm in Pittsburgh, Feb. 14. The Pratt office in Cleveland will continue to be operated, but under the name of Morris Knowles, Inc., and will be under the direct supervision of R. F. McDowell and R. E. Garvin, who were continuously associated with Mr. Pratt for several years prior to the time of his death. The various branch offices established by each organization will be continued with the possibility of others being added.

Although both organizations have done work in connection with water supply and water purification projects, sewerage systems and drainage, Mr. Pratt's organization has had wide experience in garbage and sewage disposal plants, sewerage systems and waterworks, while Morris Knowles Inc., has developed departments o. town planning, industrial housing, flood prevention, valuation and rate-making, and appraisals.

Human Element in Industry, Subject of Meeting

An illustrated description of the industrial relations obtaining in the Newburgh Shipyard, Newburgh, N. Y., was given members of the American Society of Civil Engineers at a regular meeting in New York City, Feb. 18, by Thomas C. Desmond, president of the Newburgh Shipyard, Inc. Mr. Desmond told of a condition in which the concern of the management was divided equally between the human and the technical phases of production.

Many methods were described which the yard management uses to promote the contentment, ambition and loyalty of the employees. The workers have several athletic teams and various community facilities, all of which are managed by the employees alone.

The operations of an efficiently functioning shop committee and of several plant schools conducted to train novices in the trades practiced in a shipyard were described.

International Road Association Resumes Bulletin

After an interruption lasting since June, 1914, the Permanent International Association of Road Congresses has resumed publication of its bulletin. One of the first questions raised in the first issue is as to the place where the fourth congress should be held. Both the United States and Italy have been suggested by members of the association, and the question will be submitted to the permanent international commission at the time of its next meeting, in the spring of this year.

The bulletin urges new and old members to remit their subscriptions at once. The subscriptions for individuals are 10 francs per year, 30 francs for a three-year period, and 125 francs for life membership. Subscriptions should be made payable to the Secretaire General de l'Association Internationale Permanente des Congres de la Route, 1 Avenue d'Iena (Trocadero Post Office), Paris.

Kentucky Bill to Prohibit Bridge Pooling

A bill introduced in the Kentucky House of Representatives prohibits combinations of bridge or other contractors "for pooling of prices of different competing contractors or to divide between them the aggregate or net proceeds . . . for fixing the price which any contractor shall bid."

ENGINEERING SOCIETIES

The Terre Haute Chapter of the A. A. E. recently installed the following officers: W. H. Durbin, president; N. A. Powell, vice-president, and George J. Stoner, secretary and treasurer.

The American Association of Engineers, according to a California report, has accorded membership to a second chapter in Los Angeles, Cal. The new chapter is composed of civil engineers employed on projects in Los Angeles Co. E. Earl Glass, of the Los Angeles County Flood Control District, has been elected president, and C. E. Weary, of the County Engineer's office, is the secretary.

The Albany Society of Civil Engineers held a regular meeting in Albany, N. Y., Feb. 24. Perley H. Brigham, district engineer of the Lakewood Engineering Co. of Cleveland, Ohio,

Calendar

Annual Meetings

AMERICAN RAILWAY ENGINEERING ASSOCIATION; 1426 Manhattan Bldg., Chicago; March 16-18, Chicago.

AMERICAN ASSOCIATION OF ENGINEERS; 63 E. Adams St., Chicago; May 10, 11, St. Louis, Mo.

delivered an address on "Modern Methods of Concrete Road Construction." Mr. Brigham, who was formerly an assistant engineer with the New York State Highway Department and a captain in the 23rd Engineers in France, illustrated his address with motion picture films.

The Mohawk Valley Engineers' Club was recently organized with 150 members. The policy to which the charter members of the club subscribed was that "the principal aim of this club will be to devote the talent of its members to the general good of the communities in its territory by discussion of the technical features of local and foreign engineering problems." Further elaboration of policy was presented in a report of the Committee on Constitution. The officers elected were: Byron E. White, president; Hubert E. Collins, first vice-president; Roy F. Hall, second vice-president; Horace B. Sweet, third vice-president; Frederick E. Beck, secretary; Clifford Lewis, treasurer. Regular meetings of the new club will be held on the first Tuesday of each month.

The Rochester Engineering Society at its weekly luncheon Feb. 17 was addressed by J. P. Haftenkamp on the manufacture and characteristics of *bengas*, described as a substitute fuel for automobiles.

The Indianapolis Chapter, A. A. E., recently adopted unanimously a resolution calling upon the American Association of Engineers to appoint a committee to confer, advise and work with the platform committee of the National Convention of the leading political parties, to assist in the formulation of planks in national party platforms.

The Engineers' Club of Trenton (N. J.) held a special meeting in its club rooms Feb. 19 to hear an address by Hjalmar E. Skougor, consulting industrial engineer of New York City, on the development of the natural resources of the New Jersey waterfront and waterways.

The St. Louis Railway Club met Feb. 20, in St. Louis, Mo., to hear an address on "Scientific Methods in Employment Management." The speaker was Edgar James Swift, professor of psychology and education, Washington University.

The Yakima (Wash.) Engineers Club elected the following officers at its recent annual meeting: President, D. R. Redman; vice-president, T. W. Macartney; secretary-treasurer, L. T. Jessup.

The Salt Lake Chapter of the A. A. E. has submitted to the Salt Lake, Utah, city commissioners a comparative salary schedule showing the difference in compensation received by the city and state engineers. It is maintained by the members of the chapter that the state engineers receive a much higher rate of pay than do the local engineers, and their efforts are being bent toward an equalization of compensation.

The Wyoming Engineering Society at a recent meeting in Thermopolis, Wyo., elected president, Prof. J. C. Fitterer, irrigation engineering instructor at the University of Wyoming; C. W. Zorn was elected vice-president and J. C. Chessington, secretary-treasurer. The society has 80 members.

Personal Notes

DR. WILLIAM T. SEDGWICK, senior professor of the Massachusetts Institute of Technology and head of the Department of Biology and Public Health, has been appointed first exchange professor from the Institute to the Universities of Cambridge and Leeds, England, in accordance with an understanding that grew out of a suggestion made by the late President Maclaurin of the Institute. Doctor and Mrs. Sedgwick will leave for England early in April. He will go into residence at the two unversities, dividing his time between them, and will return to this country in September. A sketch of Dr. Sedgwick's career up to his election as president of the New England Water Works Association appeared in *Engineering News*, Jan. 11, 1906, p. 31. Since then he has been president of the American Public Health Association and he is now, in addition to the position already mentioned, chairman of the Administrative Board of the Harvard-Technology School of Public Health, member of the Massachusetts Public Health Council and of the International Health Board of the Rockefeller Foundation.

HARRY R. HAYES, commissioner of public works of Utica, N. Y., for the past six years, has announced that he will return to private engineering practice as manager of the Hayes Engineering Service, Utica. He will specialize in the design and installation of municipal utilities and in city planning and valuation engineering.

ROSCOE K. EARLE, by a recent court decision has replaced Roscoe Earle Sawistowsky as city engineer of Davenport, Iowa, although there is no change of incumbent. An Iowa court recently granted Mr. Sawistowsky's petition to have his name legally changed to that of Roscoe K. Earle.

W. STEINBERGER has been appointed county engineer of Jackson County, W. Va.

GEORGE S. WEBSTER, whose term as Director of the Department of Wharves, Docks and Ferries, Philadelphia, recently expired, was immediately appointed chief engineer of that city's Bureau of Surveys, Department of Public Works. The duties of the latter office are not unfamiliar to Mr. Webster, as he held it for many years.

EDWARD P. LUPFER, Buffalo, N. Y., is one of the members appointed to the Buffalo Public Bridge Commission which was created by act of Congress to determine the possibility of building an international bridge over the Niagara River near Buffalo.

Obituary

CHARLES E. GREGORY, deputy chief engineer of the North Jersey Water Supply Commission, died of pneumonia at his home in East Orange, N. J., Feb. 21, at the age of forty-nine. Born in Stamford, N. Y., in 1871, Charles Emerson Gregory was educated in the public schools of Duchess Co. and prepared for entrance into Union College at the Poughkeepsie Military Institute. He received the C. E. degree from Union College in 1894, and with it the first honor prize of his class. His first engineering work was as resident engineer in charge of a $60,000 water-works construction at Coxsackie, N. Y., which he carried on from the time of his graduation until April, 1895. Until September, 1895, he engaged in contract construction of a canal at Middleport, N. Y., and extensions to the Coxsackie water-supply system. His next work was the direction of a $30,000 water-supply installation at Red Hook, N. Y. In 1896 he was appointed engineering inspector in the Department of Public Works, New York City, and in 1897, as transitman, was assigned to sewer work in what is now the Borough of the Bronx. He was appointed assistant engineer in 1898 and served in that capacity in the Bronx until 1906. During those years he designed the new system of sewers for the eastern portion of the Bronx which includes some of the most difficult and extensive work in New York City.

In 1906 Mr. Gregory was appointed designing engineer for the city's board of water supply, and assigned to drawing up the designs, specifications and some of the contracts for the Ashokan and Kensico reservoirs with their appurtenant bridges. Upon request of the president of the Borough of Manhattan he was transferred in 1912 to become deputy consulting engineer of that borough and in 1914 was appointed borough chief engineer of sewers. He left the employ of the City of New York in 1919 to become deputy chief engineer of the North Jersey District Water Supply Commission, which office he held until the time of his death.